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OBSERVATIONS ON THE INFLORESCENCE OF APOCYNACEAE

(With Special Reference to the American Genera of Echitoideae)

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Introduction

As one reviews the advances of plant morphology during the past quarter century and more, one can scarcely avoid recognition of the fact that systematic botanists have made few recent contributions of note to our practical and theoretical knowledge of the structure of plants. This is in spite of the fact that the whole superstructure of plant classification rests upon an intimate knowledge of such considerations. The situation is incongruous with the superior opportunities which systematists enjoy for the advancement of the very basic and elemental science of plant morphology.

In the monographic method of investigation, the systematist has developed a tool of the very greatest potentiality for the exhaustive investigation of the morphology of plants. The accumulating multitudes of specimens in the great herbaria of the world which are available for study, particularly by the trained systematist, constitute an unsurpassed field for observations concerning the known flora in its entirety with the greatest ease. The important investigations of Solereder and

others upon the anatomy of flowering plants toward the close of the past century should remind us that herbarium specimens are capable of more uses in botanical research than ordinary dissection for the purpose of identification.

The possibility of studying the inflorescence of Apocynaceae largely by means of herbarium specimens was first appreciated by the present writer while studying in the Royal Botanic Gardens and herbarium at Kew during the summer months of 1930. The accurate picture of inflorescence structure which such specimens are capable of revealing was manifest at that time upon comparison of the exsiccatae with the abundant flowering material of *Allamanda Schottii* Pohl found in the conservatories containing *Victoria regia* and other tropical species. The gardens at Kew are perhaps the richest in cultivated species of Apocynaceae among the botanical gardens of the world, and the preliminary comparison of desiccated and living specimens of numerous genera of the family found there, made possible through the courtesy of the Director, Sir Arthur W. Hill, and others in authority, has proved of the utmost value in the subsequent studies of the inflorescence of which this paper is a condensed report. Since the commencement of the problem at Kew, the writer has continued the study of the apocynaceous inflorescence in the herbarium and living collections of the Missouri Botanical Garden at St. Louis.

The taxonomy of the Apocynaceae has claimed my attention for nearly a decade during which I have examined thousands of specimens of this family deposited in the principal herbaria and botanical gardens of America and Europe. The Apocynaceae are divisible into three subfamilies, the Apocynoideae, the Echitoideae, and the Plumeroideae. The scope of my taxonomic studies has included all the recognized genera and species of Apocynoideae and Echitoideae indigenous to the western hemisphere, as well as certain related genera of Europe and Asia (Woodson, 1930, 1933). Earlier studies have also included certain genera of Plumeroideae (Woodson, 1928a, b).

Structural advantages of the flowers of Apocynaceae which overcome the disadvantages suffered by desiccation to an appreciable extent in investigating the gross morphology of the

inflorescence can be indicated at this time. The flowers of the family as a whole are large, permitting even relatively small discrepancies of age to be visible in the development and size of the buds. The rule of large flowers is broken in such genera as *Forsteronia* and *Apocynum,* but even in such instances difference in stages of development of the floral buds is clearly indicative of correlated age and potential time of blooming, very important factors in the interpretation of modes of inflorescence. Relative age of floral members is also manifest in young fruit. A less obvious criterion in this connection is found in the accrescence of the pedicels. Since the pedicels increase in length and diameter for some time preceding abscission, even in the case of flowers which have failed of fertilization, a third important clue is present in herbarium, as well as in living, specimens to enable us to determine the phenology of the inflorescence with some precision.

The range of inflorescence structure exhibited throughout the family Apocynaceae comprises nearly all the more familiar types found among the flowering plants with the exception of such specialized examples as the capitulum and the ament. The most common inflorescence is the cyme, particularly the dichasium. At this juncture it becomes necessary to outline briefly the characteristic types of inflorescence amongst the Apocynaceae, both as a hasty survey and as a definitive introduction to the succeeding discussion. It will be found that the definitions of the inflorescence follow closely those of Jackson (1900).

Dichasium.—The dichasium is the most familiar type of cymose inflorescence throughout the flowering plants. It consists of a solitary flower terminating the primary axis of the stem or branch. Subtending this flower are normally two opposite leaves or bracts in the axils of which arise two secondary branches, each terminated by a flower similar to the first, but blooming subsequently and usually simultaneously. Such an axis system is called a simple dichasium. A continuous, or compound dichasium is frequently observed in the branching of the secondary axes in a manner similar to that of the primary, and so on. Such subsidiary components of a compound cyme are designated by the diminutive *cymule.* Dichasia are

frequently so composed of innumerable flowers arranged in impressive regularity. This type of inflorescence is found in numerous genera of Apocynaceae, including *Cycladenia* Benth., *Rhabdadenia* Muell.-Arg., and *Echites* P. Br.

Aggregate Dichasium.—A "panicle" is strictly defined as a compound inflorescence all axes of which are indeterminate. This interpretation was original with Roeper (1826), to whom we owe the first thorough-going discussion of the inflorescence. Nevertheless the general use of the term, persisting since the time of Linnaeus, still permits its use for virtually any compound inflorescence, preferably pyramidal and "loose" (Jackson, 1900; Gray, 1907).

The exact opposite of paniculate construction, one in which all axes of a compound inflorescence are determinate, has apparently never received a generally accepted name, although it, too, frequently is made to masquerade as a "panicle." This type of compound inflorescence differs from the typical dichasium in that although the latter is the ultimate constituent of its construction, more than a single pair of branches occur, ordinarily at regular, decussate intervals below the determinate flower of the primary axis (cf. text-fig. 3, A). For want of a better name it is called an *aggregate dichasium,* since the inflorescence itself consists properly not of a single dichasium but of an aggregation, just as a raceme consists not of a single flower, but of an indefinite collection of them upon a specialized shoot. This type of inflorescence is conspicuous among Apocynaceae, as well as in certain other families, as Gentianaceae, being well organized in such familiar genera as *Apocynum* L., and *Forsteronia* G. F. W. Meyer,[1] accounts of which follow shortly.

Cincinnus and Bostryx.—In those cymes which consist of a single, sympodial axis, the monochasia of Eichler (1875), derivation from a dichasium has long been assumed by the substitution of a single flower for one of the equivalent inflorescence

[1] The limitations of publication preclude a complete category of the inflorescence structures of the genera of Apocynaceae which number at the present time more than two hundred.

branches. A bostryx is formed when the remaining subsidiary axis of such a modified dichasium is always either to right or to left of the determinate flower. This usually results in the somewhat curled inflorescence known as "helicoid," familiarly represented in many Boraginaceae. The maintenance of branching of such a highly modified dichasium alternately to right and to left, resulting in a somewhat zigzag sympodium widely known as "scorpioid" is characteristic of the cincinnus. In the bostryx and the cincinnus the sympodium is usually more or less curled or zigzag respectively. They may be simple throughout, or variously branched, by which they may recall their dichasial ancestry to a certain extent. Not infrequently the axis may become quite straight, however, when the nature of the sympodium must be distinguished by the usually paired pedicels in the axil of a single bract which is opposed to an "empty" bract upon the other side of the peduncle (cf. pl. 3, fig. 3). The peduncle is literally in the axil of the "empty" bract, which frequently becomes greatly dislocated in highly modified scorpioid and helicoid cymes, rendering their interpretation less easy.

The bostryx and the cincinnus occur widely throughout the Apocynaceae, the former in such genera as *Odontadenia* Benth., *Allamanda* L., and *Asketanthera* Woods., and the latter in *Prestonia* R. Br., *Temnadenia* Miers, and *Mesechites* Muell.-Arg. Scorpioid and helicoid modifications frequently creep into the ramifications of other cymose types, particularly when multiflorous.

Raceme.—Scarcely distinguishable from some highly modified examples of superficially indeterminate scorpioid and helicoid cymes is the truly indeterminate raceme. A typical raceme may be defined as a simple, pluriflorous, monopodial inflorescence in which a solitary pedicel is borne in the axil of a single bract. A pronounced peduncle is usually present which is of relatively greater length than the individual pedicels. Familiar modifications of the typical raceme are the spike, the corymb, and the umbel, based upon the relative length, or essential suppression of peduncle and pedicels. Typical racemes are infrequent in Apocynaceae, the principal genus bear-

ing them being *Mandevilla* Lindl., of some 108 species of the western hemisphere.

Jackson (1900) defines the umbel as "properly indeterminate," but recognizes the use of such a term as "cymose umbel" for those which are centrifugal and not centripetal in their floral development. Similarly, the same authority defines both a spike and a corymb as indeterminate. In these cases also it appears inevitable to recognize determinate as well as indeterminate spikes and corymbs. In such species as *Forsteronia paludosa* Woods., it will further be necessary to deal with a spiciform thyrse: a typical thyrse in which the pedicels are suppressed. Corymbs, in their typical, indeterminate sense, are restricted to racemose genera, as in *Mandevilla callacatensis* Mgf. The true umbel in Apocynaceae is unknown to this writer. Cymose, or determinate, corymbs and umbels are widely observed in such genera as *Prestonia* R.Br., *Thenardia* HBK., *Malouetia* A.DC., and *Asketanthera* Woods.

The spike, the umbel, the corymb, and other similar types, are doubtless merely modes of more fundamental types of inflorescence, and it would appear more simple in the end to use them in an adjectival manner, such as "corymbose raceme," and "corymbose cyme," than to limit the use of the word "corymb" to an indeterminate structure, in which case there would be an obvious necessity for another word to express similar, but determinate construction.

Thyrse and Panicle.—The thyrse and the panicle are recognizable as compound inflorescences in which the primary axis is indeterminate. In the true panicle, as represented by the common lilac, *Syringa vulgaris* L., the subsidiary axes, whatever their number, are likewise indeterminate. In the thyrse, however, the ultimate ramifications of the inflorescence are determinate, hence the "mixed inflorescence" of A. P. De Candolle (1827). The modification of the thyrse is excellently shown in the apocynaceous genus *Forsteronia*, amongst others, in which the determinate construction is variously expressed upon branches of differing magnitude throughout the entire inflorescence. The true panicle apparently is not found in any known Apocynaceae, although it is approached in certain species of

Forsteronia, a detailed account of which is reserved for succeeding paragraphs.

Solitary Flowers.—Solitary flowers are found in both terminal and lateral positions in the Apocynaceae. The former is typical of such genera as *Salpinctes* Woods., and such exceptional species of predominantly pluriflorous genera as *Echites crassipes* A. Rich. In all known instances, however, very inconspicuous, subtending bracts are usually capable of detection. In the familiar creeping myrtle, *Vinca minor* L., the solitary, lateral flowers are without the slightest evidence of subtending bracts. The different condition of the closely related periwinkle, *Lochnera rosea* (L.) Rchb., will be discussed presently.

Closely correlated with the predominance of cymose inflorescence in the family Apocynaceae is the occurrence with but few exceptions of decussate phyllotaxy. So much has been written concerning the spiral arrangement of appendages of the shoot as "primitive," a term of all too vague implications in many instances, that observations to the contrary might appear to have been suppressed by the sheer weight of consensus of opinion among morphologists. In the case of Apocynaceae, however, the reverse appears obvious.

Among the 132 genera recognized within the family by Schumann (1895) only twelve are characterized by spiral phyllotaxy. Of these, but one and two respectively are contained within the subfamilies Apocynoideae and Echitoideae, which have been found to have an elementary, or "primitive," carpological structure predominating (Woodson, 1930), while the alternate-leaved genera of Plumeroideae, characterized by the occurrence of generally more complicated, or "advanced," carpological conditions, number nine. Whorled phyllotaxy is found in fourteen genera of Plumeroideae and four of the Echitoideae enumerated by Schumann. In this connection it appears significant that of the eighteen genera with whorled phyllotaxy, no less than seven[1] are known to contain at least one species with normal, decussate foliage. In this, as in other

[1] *Aspidosperma, Condylocarpon, Couma, Gynopogon, Laubertia, Macrosiphonia, Pycnobothrya.*

families, there is an obvious correlation of whorled and opposite phyllotaxy indicating the derivation of the former from the latter, possibly by the aggregation of nodes.

Such deductions as the immediately preceding receive additional support by observations on the young seedlings of *Amsonia* spp.[1] and *Rhazya orientalis* (Dcne.) A. DC., the first stem-leaves of which are characteristically decussate. Two alternatives effect the adult, spiral phyllotaxy. In numerous instances among the seedlings under observation lateral buds were produced *in the axils of the cotyledons*. Upon subsequent development the arrangement of leaves upon such lateral branches was found in all cases to be normal for the adult condition of the species. The plumular shoot was short-lived. Somewhat less frequently among the seedlings a gradual change from decussate to spiral phyllotaxy was seen to occur upon the plumular shoot by the vertical translocation of nodes. The juvenile shoot was thereupon transformed directly to the adult condition. In innumerable instances more or less conspicuous vertical translocation of individual foliar nodes may be observed in species of Apocynaceae with normally opposite phyllotaxy.

Upon physiological-anatomical grounds opposite phyllotaxy and the occurrence of perfectly cymose inflorescence would appear to be unavoidably correlated. To many botanists the chief, if not the only, important characteristic of the cyme is the fact that for each axis a solitary, terminal flower exists which may be associated with a variable number of subsidiary floral members developing in basipetal succession. A most essential feature of the perfectly compounded cyme which has been overlooked generally, even by some students of inflorescence structure, is the almost geometrical precision which governs the expansion of its floral members. In such a simple dichasium of three flowers as has been described in a preceding paragraph, observable in innumerable genera of flowering plants in such families as Caryophyllaceae, Primulaceae, Gentianaceae, Apocynaceae, etc., the primary floral member termi-

[1] *A. Tabernaemontana* Walt., *A. brevifolia* A. Gray, *A. illustris* Woods., *A. pogonosepala* Woods.

nating the vegetative axis of stem or branch invariably blooms first. This is soon followed by the nearly simultaneous expansion of the two equivalent, lateral floral members immediately subtending.

If the dichasium be compounded to include for either branch a pair of lateral floral members subtending the secondary determinate pedicels, these will bloom shortly thereafter, in almost clock-like concert. This very impressive similarity of composition and unison of development of equivalent members of "perfect" cymes may appropriately be referred to collectively as its characteristic, or elemental "symmetry."[1] Common observation will probably lead one to object at this juncture that many, if not most, cymose inflorescences are not possessed of one or both of these "ideal" attributes under actual living conditions. Such is doubtless the case, and the remainder of this paper will be devoted to the occurrence of such irregularities among certain Apocynaceae and their possible evolutionary significance.

It is a fact quite easily observed that truly "perfect" cymes, whether di- or pleiochasia or derivatives of these, are found only upon flowering plants with opposite or whorled phyllotaxy. In no alternate-leaved species has this writer observed the strikingly symmetrical development of equivalent floral members so characteristic of the "perfect" (e. g. "ideal") cymes. The reason is doubtless anatomical and physiological: an inflorescence borne at the lower of two translocated nodes receives its vascular supply from the apical meristem somewhat earlier than the inflorescence immediately above. Hence subsequent development of the floral members is slightly in advance of that of the cyme immediately above, in spite of the fact that the two would be "equivalent" in the event of opposite phyllotaxy.

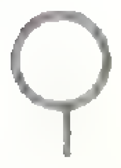
Although observations have been made over an unusually wide assortment of specimens during a number of years, as has been indicated in a preceding paragraph, the chief trends of

[1] This theory of the elementary symmetry of the ideal cyme will be found to place more emphasis upon the factor of time in development than the somewhat similar conception of "rhythm and symmetry" propounded by Goebel (1931).

the evolutionary development of the inflorescence in Apocynaceae may apparently be visualized from a review of a few characteristic representatives. In spite of the inevitable loss of minute detail, such an abbreviated account should possess a degree of clarity and simplicity difficult of attainment in a more extended, if more comprehensive account. It has been a matter of considerable disappointment that anatomical observations have been impossible because of the difficulty in securing fresh material of the critical genera. It is hoped that such data may eventually be secured to test the wholly gross morphological account which follows.

A final word of caution may be necessary to emphasize that perhaps no phase of the flowering plant's gross morphology is more variable than the inflorescence. The inflorescence is essentially a phase of branching of the shoot system, but it is vastly more complicated than vegetative branching, from which it has been derived. Hence the examples of inflorescence used to illustrate the observations which follow must be understood to represent *tendencies* perceived after wide study: they represent by no means the whole range of variation of a genus or species.

Explanation of Symbols Used in Diagrams.—In the diagrams illustrative of the succeeding paragraphs, dimensions have been maintained constant, despite disparities of the inflorescences in nature. The following symbols have been employed to denote floral members:

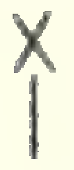
 — floral bud.

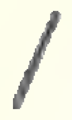
— flower at anthesis or shortly thereafter.

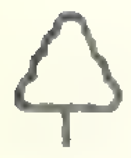
— fruit (in this and the preceding the relative size of symbols is indicative of the corresponding degree of development upon the actual specimen observed).

— bract.

— leaf.

 — undeveloped bud, floral or vegetative.

 — broken portion of specimen.

 — whole mature inflorescence.

— immature inflorescence.

The limitations of diagrammatic representation render impractical an attempt to indicate the decussate or spiral composition of the inflorescence. Branches, pedicels, and bracts which appear opposite and in the same plane must be interpreted as naturally decussate: similarly with the alternate members appearing as in the same plane which must be construed as naturally spiral.

Observations

Echites P. Br.

Our present knowledge of the genus *Echites (sensu stricto)* is limited to seven species and a putative variety which may be separated provisionally into four sectional groups centering about *E. tuxtlensis* Standl., *E. turbinata* Woods., *E. yucatanensis* Millsp., and *E. umbellata* Jacq., respectively. The aspect of the inflorescence of these species is reproduced in pls. 1–2. The best-known species of *Echites,* as well as the type of the genus, is *E. umbellata* Jacq., a liana occurring virtually throughout the Greater Antilles and extending to southern peninsular Florida, the Bahama Islands, and the coastal flats of northern Yucatan and British Honduras. The inflorescence of this species consists of one to several flowers, two, three, or four being the predominant numbers, borne in corymbose cymes. Tendencies of the inflorescence may be discussed briefly with the aid of five sketches provided in pl. 1.

The cymes of *E. umbellata* are predominantly alternate-lateral, but may be pseudoterminal as well. Such an individual is shown in pl. 1, fig. 5. In this case the axis is terminated by a

flower in full bloom. The two lateral branches bear one and two buds respectively, the solitary bud to the left being conspicuously larger than either of the two upon the opposite branch. The paired bracts of the branch to the right, in the axil of one of which the smaller lateral bud is found, indicate that the present condition was probably derived from a perfect cymule of three floral buds. Detection of a minute, abortive bud in the axil of such a superficially "empty" bract is usually possible upon careful dissection. At the base of solitary, lateral pedicels as that to the left of the figure are usually found a few rather indefinite, tiny bracts, also indicating that the uniflorous condition has probably been derived from a lateral cymule.

In fig. 2 of the same plate an inflorescence is shown in which the right lateral branch of the dichasium has failed to develop in the axil of its subtending bract which remains. The terminal flower is full blown. The left lateral branch consists of three well-developed, and one abortive, buds. The terminal bud of this cymule is about to expand, and is the largest of the three. The lateral bud to the left of the terminal is manifestly next in size, and is undoubtedly interpretable as the remnant of a reduced lateral cymule. The terminal bud of the right cymule is the smallest of the functional buds, and this fact appears to be correlated with the presence of the abortive, lateral bud at its base. Evidently the right cymule is slower to develop than the left because its axis has not been stripped of subsidiary axes dependent upon its vascular supply. At any rate, an examination of many specimens demonstrates an indubitable association of advanced development and potential blooming with increased reduction of the inflorescence.

Plate 1, fig. 1 illustrates a dichasium of three members, the terminal pedicel of which is bearing young fruit. The two lateral flowers are of approximately equal development. Two explanations of this cyme are possible: that the inflorescence as such is basic and elemental, or that the two lateral members have been reduced from pluriflorous, lateral cymules to the same degree, and thus expand with approximate simultaneity. Figure 4 represents a uniflorous condition of the inflorescence

of *E. umbellata,* not uncommonly found, in which, however, two abortive buds subtend. The truly uniflorous condition, without the presence of one or more abortive buds, has not yet been observed in this species.

In *E. crassipes* A. Rich., however, solitary flowers are borne, and with the aid of somewhat smaller foliage serve to distinguish this poorly understood endemic of Cuba. Even in the instance of this species, nevertheless, an indefinite and small number of minute bracts at the very base of the pedicel gives strong support to the assumption of reduction from a plurifiorous dichasium (pl. 1, fig. 3). The scope of variation in the relatively small inflorescence of *E. umbellata* increases with the number of specimens examined, and is plainly impossible to describe adequately at this time. An examination of even a few, however, is sufficient to form the opinion that the inflorescence of the species as a whole is undergoing reduction, and that the progressive reduction of a cymule tends to hasten the development of the remaining flower buds in relation to those of less reduced but equivalent cymules.

Plate 2 represents the inflorescence of four additional species of *Echites.* The group centering about *E. yucatanensis* is confined to Central America, and is most tangibly separated from the Antillean *E. umbellata* by the absence of the spiral contortion of the corolla-tube of the latter. Although the dichasium has advanced decidedly toward the umbellate condition, the general tendencies of the floral development of the former (pl. 2, fig. 3) are conspicuously similar to those of the latter species. In *E. turrigera,* known only from Guatemala, the inflorescence (pl. 2, fig. 4) is an almost typical, pluriflorous dichasium. Here also, however, the influence of unequal reduction of equivalent cymules in the disruption of the cymose symmetry is in unmistakable evidence.

Conspicuously smaller flowers set apart *E. tuxtlensis* and *E. turbinata* from the other species of *Echites.* Here also the inflorescence is noticeably more extensive. In the former (pl. 2, fig. 1) a cyme is found in which the primary branching is dichasial and the subsequent composition helicoid. From the previous observations upon *E. umbellata* one may be led to

infer that here, and perhaps in all such helicoid cymes, the single, outer flowers of the sympodium, blooming only slightly subsequent to the expansion of the median, or terminal flower, have been hastened in their relative development by their previous reduction from a pluriflorous cymule.

The inflorescence of *E. turbinata* (pl. 2, fig. 2) is of puzzling nature, the first branching being typically dichasial, but the ultimate branching apparently partaking of the nature of the aggregate dichasium, since each of the three members is subtended by one or two small, probably abortive, floral buds, or by paired bracts. A logical explanation is that in this species a simple dichasium is being derived from the extensive modification of a more complex system. As this species, which is an endemic of Costa Rica, is extremely rare in herbaria, it may be hoped that a fuller understanding of its inflorescence will result from increased collections.

Apocynum L.

Promising clues to the origin of the aggregate dichasium are found in *Apocynum*, a genus of few species remarkably widespread over temperate North America. In *A. cannabinum* L., a ubiquitous weed of fields and roadsides, the inflorescence is predominantly terminal and multiflorous, consisting of a much ramified aggregate dichasium (text-fig. 1, A). Accompanying the terminal inflorescence are always two subsidiary, lateral shoots, both of which may bear a varying number of foliar nodes, in which case both eventually terminate with an inflorescence similar to the first. In many instances only one of such branches produces foliage; in this case the other produces directly an inflorescence similar to the first, but usually somewhat smaller. Naturally this second lateral inflorescence comes to full development much sooner than the first because of the elimination of the intervening foliar nodes. In many instances both lateral shoots may produce inflorescences directly without the production of foliage, in which case they become an integral part of the terminal inflorescence.

Apocynum cannabinum is an obnoxious weed largely because of its size and long period of bloom. These attributes are the

result of its ability to produce inflorescences through a relatively long season by means of its dichotomous or cymose branching. A much less pestiferous weed is *A. androsaemi-*

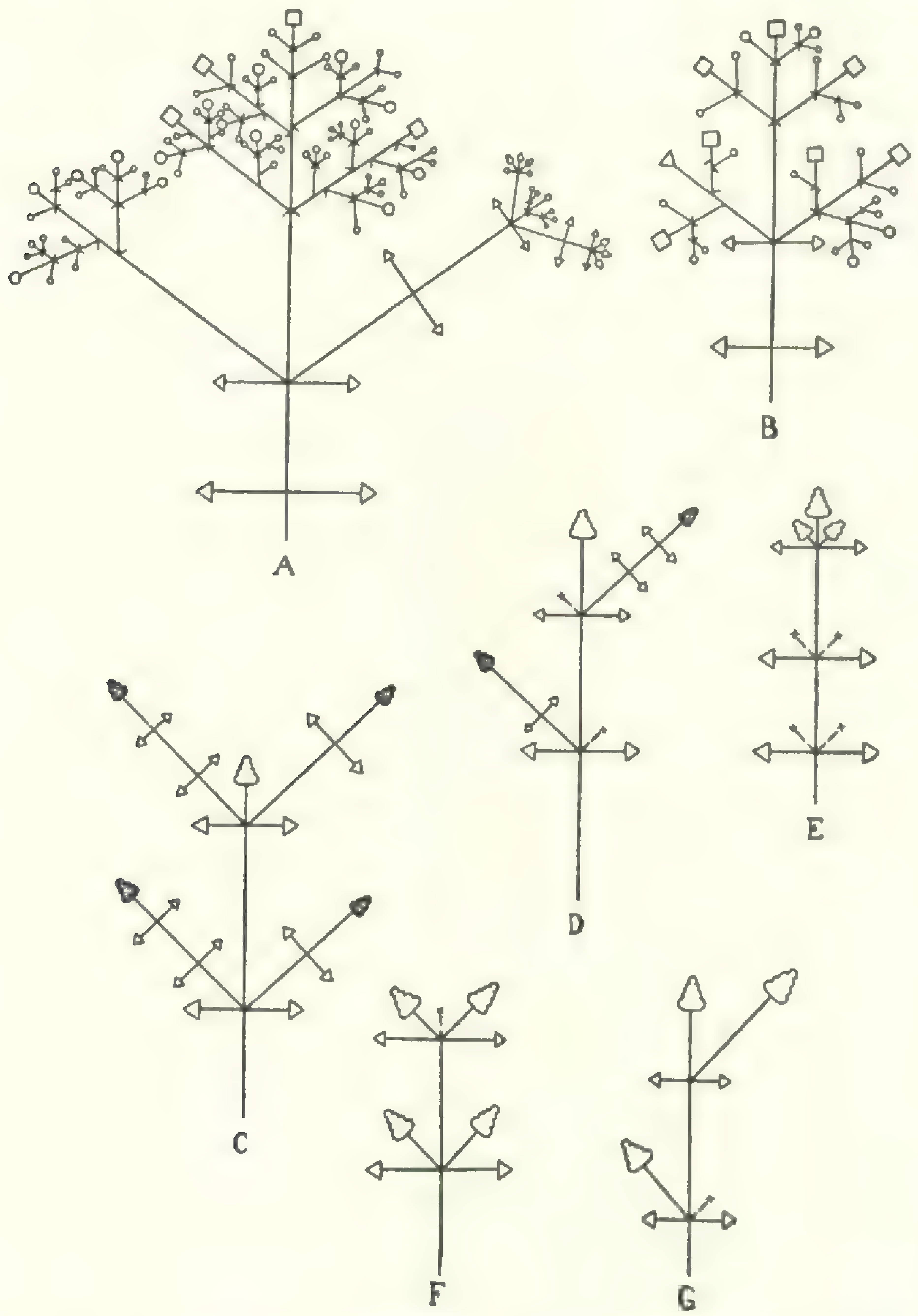


Fig. 1. Inflorescence structure: A—*Apocynum cannabinum* L.; B—*A. androsaemifolium* L.; C—*Forsteronia leptocarpa* (Hook. & Arn.) A.DC.; D—*F. paludosa* Woods.; E—*F. spicata* (Jacq.) G. F. W. Meyer; F—*F. amblybasis* Blake; G—*F. elachista* Blake. Explanation in the text.

folium (text-fig. 1, B), in which the lateral shoots accompanying the strictly terminal or median inflorescence do not tend to elongate as in the sister species. The blooming period, as well as the size of this species, is consequently relatively less.

"Aggregate dichasium" is evidently a well-chosen name for the inflorescence of *Apocynum,* from the phylogenetic standpoint; for if we read the data properly, it has been derived by the aggregation of a number of terminal dichasia through the elimination of the foliar nodes subtending them, hence the decussate composition of its branches. Recapitulatory evidence appears to occur in the inflorescence of *A. androsaemifolium* and other species, in which bracts of the median axis of the aggregate dichasium occasionally regain to a limited extent their foliar character.

Apocynum is apparently the only genus of Apocynaceae in which the origin of the aggregate dichasium may be read so easily. In the closely related genus *Trachomitum* Woods. of Eurasia, the inflorescence has become about as highly organized as in *Forsteronia,* an account of which follows. In *Poacynum* Baill., a close Asiatic relative of *Apocynum* and *Trachomitum,* the branches of the aggregate dichasium have undergone scorpioid modification.

Odontadenia Benth.

The evolution of the inflorescence of the echitoid genus *Odontadenia* would appear to approach the cincinnus from both the typical and the aggregate dichasium. Significant stages in this progression, drawn from representative species, are illustrated in text-fig. 2.

The inflorescence of *O. Hoffmannseggiana* (Steud.) Woods. is a variously modified, aggregate dichasium bearing few to relatively numerous flowers (text-fig. 2, A). In the specimen illustrated, which was collected by Tessmann in eastern Peru, two flowers are full-blown, one terminating the median axis, and one terminating the subsidiary axis to the right of the figure. It is clear that the floral bud terminating the equivalent, secondary axis to the left has failed to keep pace with the development of the sister determinate flower, and this fact is correlated with the fact that the cymule is composed of four flowering nodes and the one to the right of but two. It is significant also that the tertiary axes of the right cymule are in different stages of relative development: that to the left, consisting of

but one floral bud, is in a conspicuously more advanced stage than either of the three comprising that to the right. The same situation is found with respect to the two subsidiary cymules of

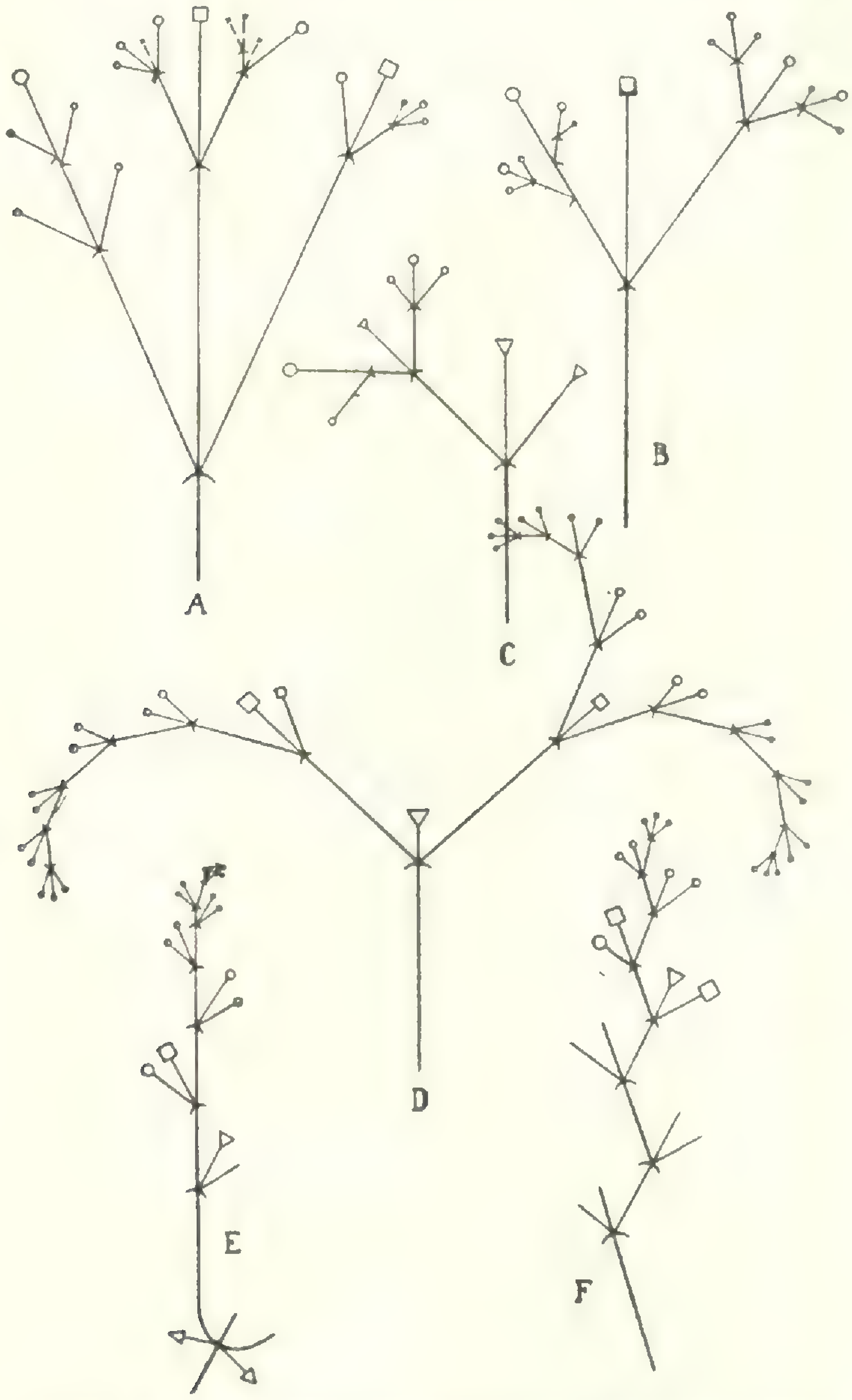


Fig. 2. Inflorescence structure: A–C—*Odontadenia Hoffmannseggiana* (Steud.) Woods.; D.—*O. laxiflora* (Rusby) Woods.; E—*O. polyneura* (Urb.) Woods.; F—*Angadenia Sagraei* (A.DC.) Miers. Explanation in the text.

the median axis, each consisting of four members, with abortion plainly in progress in the case of one and three of either cymule to the left and right respectively. The physiological result is clearly evident in the relatively advanced stage of development of the lone functional bud to the right.

The first stages of the development of a cincinnus are also observable in *O. Hoffmannseggiana.* In text-fig. 2, C, an instance is found in which the inflorescence consists of a primary, fruiting pedicel and two strongly unequal, secondary branches of one and six functional pedicels to right and left respectively. Although it happens that young fruit terminates both secondary axes of the dichasium, the size of the symbols is expressive of a significant disparity in relative development exactly like that found under similar circumstances in floral members.

An additional factor of great importance in the modification of the inflorescence is found in the effect of the vertical translocation of nodes. The translocation of the equivalent, tertiary cymules to the left of the inflorescence illustrated in text-fig. 2, B, shows that in such cases the members of the lower node are hastened appreciably in their development, even though those of the upper node may be somewhat more reduced in numbers. This fact, again, requires but an obvious anatomical-physiological explanation, since the lower node, differentiated first from the apical meristem, is effectively joined to the functioning conductive tissues of the shoot and root at a somewhat earlier time than the upper. Hastened development of its subtending members follows.

In *O. laxiflora* (Rusby) Woods. a peculiar modification of the inflorescence is found in which the main axis is regularly dichasial, but the secondary branch to the left has become helicoid by the repeated reduction of the right branch of each cymule to a solitary floral bud (text-fig. 2, D). The secondary branch to the right is compounded dichasially to the tertiary axes, which then become helicoid. The terminal flower of the secondary branch to the left naturally blooms before that of the branch to the right because of the greater degree of reduction of its axis.

The modification of the dichasium to a simple cincinnus is culminated in *O. polyneura* (Urb.) Woods. (text-fig. 2, E), in which a superficially indeterminate axis is compounded by paired pedicels borne in alternate succession subtended by one of a pair of bracts. The flowering axis is clearly a scorpioid sympodium, although it has lost the conspicuous zigzag aspect of less highly modified scorpioid inflorescences, as that of *Angadenia Sagraei* (A. DC.) Miers, illustrated in text-fig. 2, F.

FORSTERONIA G. F. W. Meyer

The inflorescence of *Forsteronia* has been described rather loosely as a panicle. A thorough study of representative species discloses the fact that a true panicle is absent in all. Various modifications of the thyrse are predominant, varying from typical, pyramidal outline to structures which superficially resemble the corymb and the spike, through the elongation or the virtual elimination respectively of the subsidiary axes. The recent discovery of a species with the structure of an almost typical, corymbose raceme heightens the significance of the inflorescence structure of this genus, and renders its study of great value in the evolutionary history of flowering axes generally. Text-fig. 3 provides diagrams of the inflorescence of various representatives of this genus.

The inflorescence of *Forsteronia* is composed of many flowers of relatively small size, rendering analysis and interpretation somewhat difficult. Relatively young inflorescences, frequently collected separately and preserved in small packets upon herbarium sheets, have been found extremely useful for study, since they may be boiled *in toto,* restoring a semblance of the living posture. After study such specimens may be partially dried and pressed between blotters, from whence they may be returned to the herbarium packets after complete desiccation. Such procedure serves to emphasize the convenient use of herbarium specimens for the study of gross morphology beyond the usual practice of taxonomic identification.

The elemental type of inflorescence in *Forsteronia* would appear to be the many-flowered, aggregate dichasium, such as that of *F. corymbosa* (Jacq.) G. F. W. Meyer, *F. floribunda* (Sw.) G. F. W. Meyer, and *F. portoricensis* Woods. In such an inflorescence (text-fig. 3, A), the terminal flowers of the median, as well as those of all secondary axes, bloom with approximate unison. It is possible that this rather arresting phenomenon may be in large part due to the successive reduction of the number of floral members borne upon the secondary axes from bottom to top, resulting in the pyramidal outline.

Focusing our attention upon the individual composition of the lateral members, it is found that the tertiary branches are

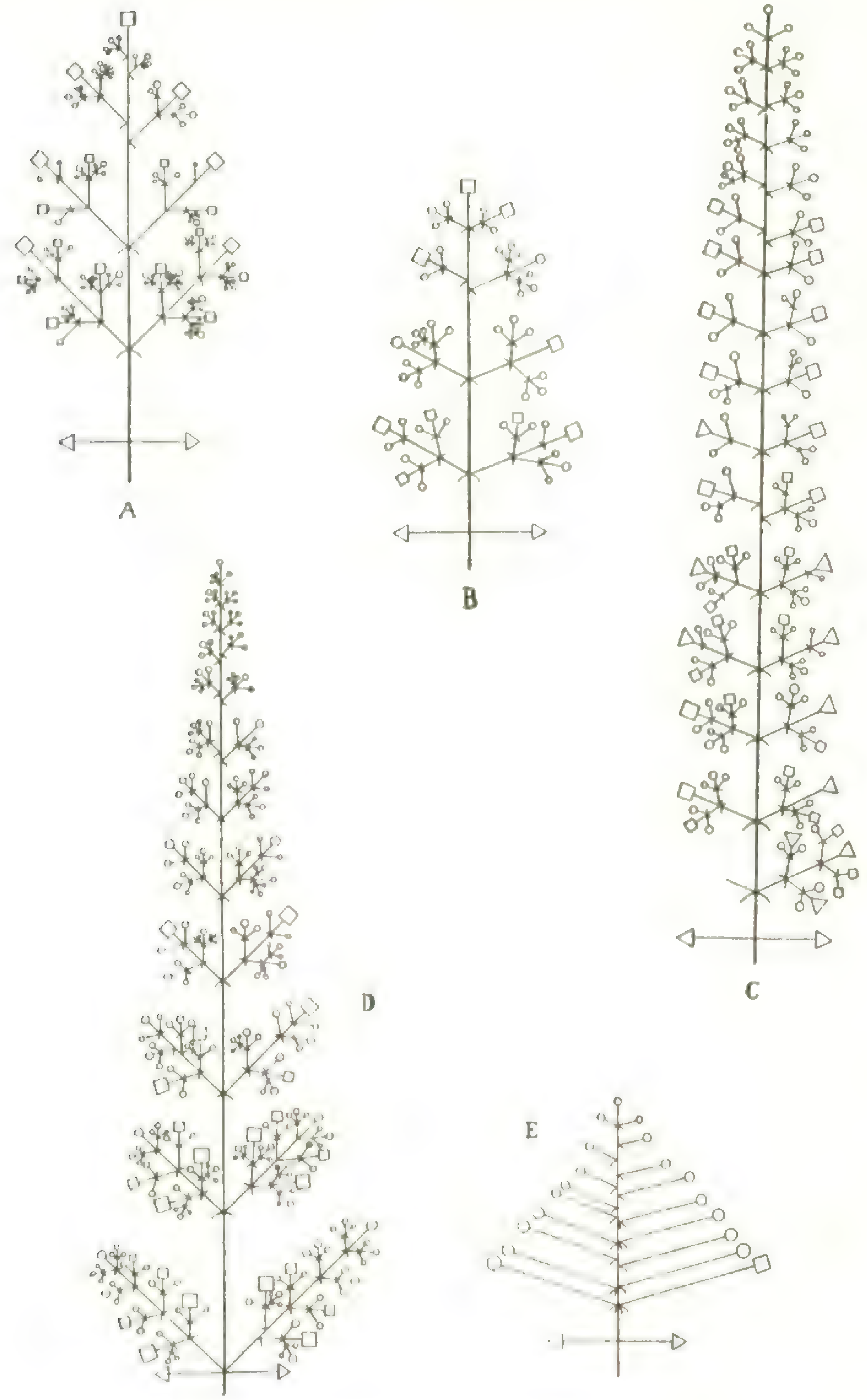


Fig. 3. Inflorescence structure: A—*Forsteronia corymbosa* (Jacq.) G. F. W. Meyer; B—*F. Velloziana* (A.DC.) Woods.; C—*F. thyrsoidea* (Vell.) Muell.-Arg.; D—*F. leptocarpa* (Hook. & Arn.) A.DC.; E—*F. simulans* Woods. Explanation in the text.

dichasial. The slight nodal translocation has apparently not succeeded in influencing effectively the phenology of the inflorescence.

The inflorescence of *F. Velloziana* (A. DC.) Woods. is a corymbose structure intermediate between the aggregate dichasium and the thyrse (text-fig. 3, B). In this inflorescence the symmetrical expansion of the terminal flowers of the secondary axes has been disrupted effectively by the reduction of certain branches, resulting in hastened development of certain of the floral members. The primary axis, however, is still determinate.

The first indications of the modification of the aggregate dichasium to the thyrse seen in *F. Velloziana* lead to the inflorescence type of *F. thyrsoidea* (Vell.) Muell.-Arg. (text-fig. 3, C), which is more or less typical of the thyrsiform structure, since the main axis is indeterminate with respect to the secondary axes, which still retain their dichasial composition variously modified. In this extensive inflorescence the small amount of variation in flower numbers among the secondary cymules from the first to the fifteenth pair of nodes can perhaps be explained by the assumption of reduction in number of floral members in basipetal succession. This assumption would also aid in explaining the acropetal development of the secondary cymules which is evident.

Typical panicles are apparently never found in Apocynaceae. The paniculate structure is closely approximated in the inflorescence of *F. leptocarpa* (Hook. & Arn.) A. DC., in which both the main and the secondary axes are indeterminate, although the tertiary and lesser branches remain determinate (text-fig. 3, D). The factors influencing the indeterminate modification of the primary axis of *F. thyrsoidea* may safely be supposed to have been identical with those effecting the indeterminacy of the secondary axes of *F. leptocarpa*.

Our knowledge of the evolution of the inflorescence in *Forsteronia* is culminated in *F. simulans* Woods., a rare liana of Colombia, in which the inflorescence is superficially a corymbose raceme with simple lateral pedicels. From the diagram of this "raceme" provided in text-fig. 3, E, however, have been

omitted numerous extremely inconspicuous bracts and abortive buds occurring rather irregularly upon the peduncle amongst the floriferous pedicels, which further exhibit a marked tendency of translocation. It appears obvious that this inflorescence has been derived from a thyrse characteristic of neighboring species.

One can scarcely fail to be impressed by the great range of modification of the inflorescence amongst species of *Forsteronia* which would appear to offer a most significant clue toward the solution of the questioned relationship of determinate and indeterminate inflorescences. The remaining known species of *Forsteronia,* numbering forty-one, present various gradients of the inflorescence structures of the five examples discussed in the preceding paragraphs. The great bulk of these show certain tendencies centering about the types represented by *F. Velloziana, F. thyrsoidea,* and *F. leptocarpa.* It is significant that although the inflorescence has not been employed to a great extent in the taxonomic separation of the species in a recent revision by this writer, additional morphological criteria used in speciation have resulted in a concurrent classification.

Species of *Forsteronia* show a progressive transformation of vegetative to floriferous axes, distinctly recalling that previously discussed in *Apocynum,* but in greater variety. In *F. leptocarpa* (text-fig. 1, C), the terminal, aggregate dichasium is regularly accompanied by two lateral, vegetative shoots which continue the extension of the massive liana characterized by this species. Each of such vegetative branches may be compounded similarly. A somewhat similar method of branching is found in *F. paludosa* Woods., in which, however, a single lateral branch is developed in alternate axils of the decussate leaves. An abortive, or dormant bud is regularly found in the axil of the opposite node, which can become stimulated to growth upon injury of the stem above its occurrence (text-fig. 1, D).

In *F. elachista* Blake a lateral inflorescence occurs with the strictly terminal, occupying the alternate axils of the foliar nodes as in the vegetative branches of *F. paludosa* (text-fig.

1, G). In the case of numerous tropical Apocynaceae, notably species of *Odontadenia,* an indefinite number of cataphylls are found occurring at the base of such lateral inflorescences. These are not observed subtending vegetative branches, or they are inconspicuous. A natural assumption which presents itself is that the alternate lateral inflorescences of *F. elachista* are homologous with the vegetative branches of *F. paludosa.* In *F. spicata* (Jacq.) G. F.W. Meyer (text-fig. 1, E), terminal inflorescences are accompanied by opposite lateral inflorescences. In *F. amblybasis* Blake the tip of the branches frequently appears to produce a dichotomous inflorescence of equal halves (text-fig. 1, F). This phenomenon is shown to have been produced by the non-development of a terminal floriferous axis, traces of which can frequently be observed. Normal opposite-lateral inflorescences also occur in this species.

MANDEVILLA Lindl.

The large genus *Mandevilla,* consisting of approximately 108 known species, is typified among the American representation of the subfamily Echitoideae largely by simple, racemose inflorescence. The mode of raceme is diverse both in number of floral members and gross construction, varying from rather lax corymbs to elongate spikes amongst neighboring species. Diagrams of the chief types of inflorescence are provided in text-fig. 4.

It would appear highly significant that *Mandevilla* and *Forsteronia,* in which the tendency from determinate to indeterminate inflorescence is clearly evident, are closely neighboring genera. The foliar glands of the majority of Forsteronias are of almost the same structure and occurrence as those of *Mandevilla* subgen. *Eumandevilla,* and the construction of the anthers of either genus is closely similar. An additional factor of great importance is found in the stigmata, or "clavuncles," which are massive and umbraculiform in all species of *Mandevilla,* and in all save one species of *Forsteronia* are fusiform to subcapitate. The exceptional species of the latter genus is *F. simulans* Woods., with an umbraculiform stigma which could

scarcely be distinguished from that of a Mandevilla. It will be recalled that the inflorescence of *F. simulans* further approaches that of *Mandevilla* in its virtually racemose character.

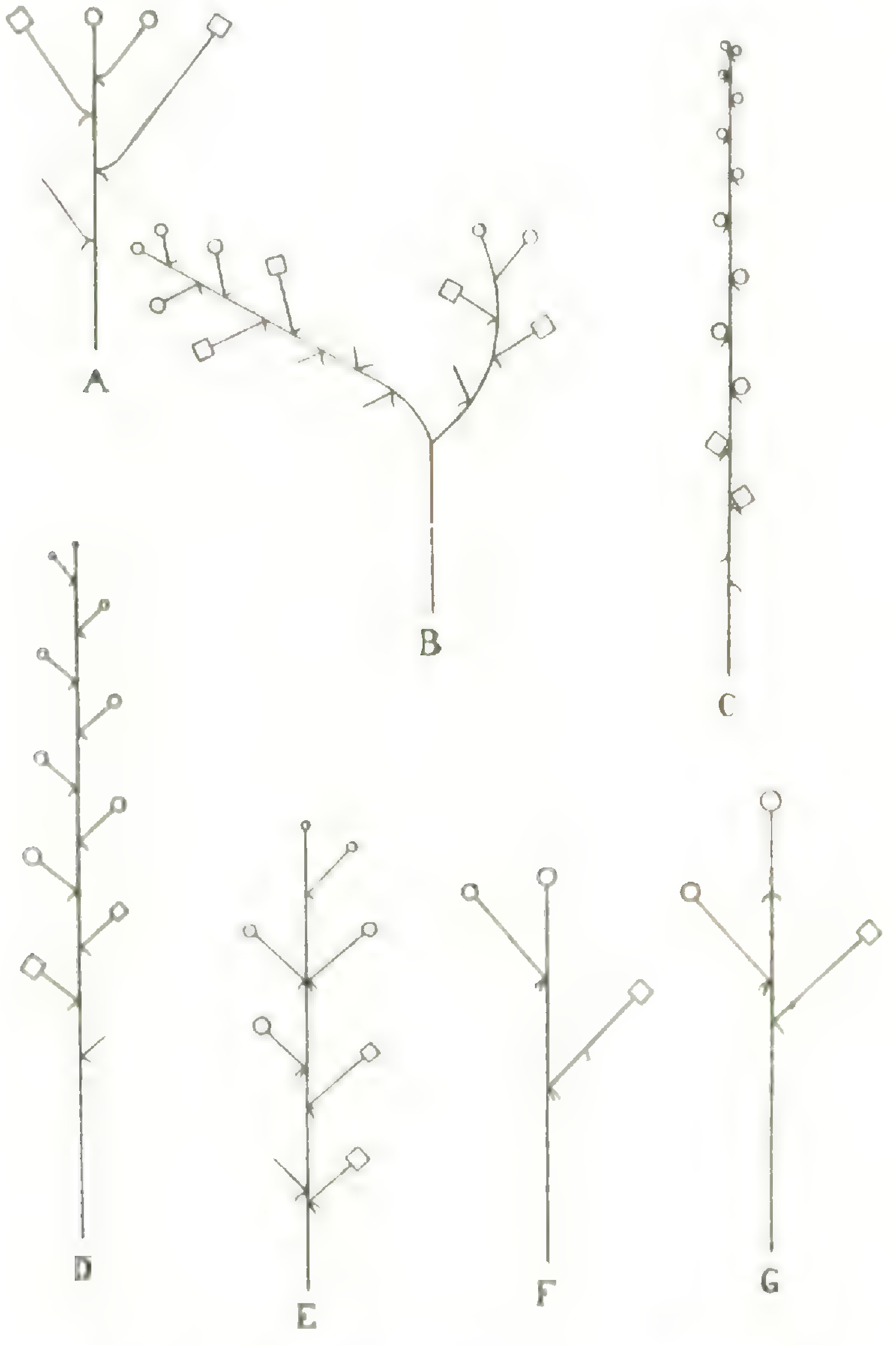


Fig. 4. Inflorescence structure: A—*Mandevilla callacatensis* Mgf.; B—*M. subpaniculata* Woods.; C—*M. scabra* (R. & S.) K.Sch.; D–G—*M. xanthostoma* (Stadelm.) Woods. Explanation in the text.

Although the inflorescence of the greatly preponderant number of Mandevillas may be characterized as simply racemose, a few, but highly significant exceptions occur. In *M. subpaniculata* Woods. (text-fig. 4, B), indubitable evidence of reduction from a compound inflorescence is found. That such composi-

tion is the effect of reduction, rather than of aggregation as was seen in *Apocynum,* for example, appears to be indicated in the fact that any such compounding is not in harmony with the vegetative symmetry of the shoot, but occurs somewhat irregularly, and often more obscurely than in the example figured. Less obvious clues leading to the conclusion of reduction are observable in the inflorescences of the closely related *M. Achrestogyne* Woods. and *M. bogotensis* (HBK.) Woods.

In *M. xanthostoma* (Stadelm.) Woods., an herbaceous and evidently a highly evolved member of this genus formerly included in the morphologically invalid genus *Dipladenia,* an interesting series of variations in inflorescence composition occurs which can scarcely be viewed other than as indicative of inflorescence phylogeny. A random collection of four such variations has been illustrated by diagrams in text-fig. 4, D–G, notes upon which follow:

1. Normal, or many-flowered, inflorescences of *M. xanthostoma* are of the typical, racemose type with alternate pedicels subtended by solitary bracts. Such inflorescences average roughly eleven to thirteen functional pedicels (text-fig. 4, D).
2. Abnormal, or relatively few-flowered, inflorescences tend toward a "pseudo-bostrychoid" racemose type with opposite pedicels, either or both subtended by more than one bract (text-fig. 4, E).
3. Multiplicity of bracts is frequently associated with opposite pedicels and reduced inflorescences, but not invariably (text-fig. 4, F).
4. The raceme may terminate indeterminately as well as pseudo-determinately by a terminal flower expanding slightly before the bud immediately below (text-fig. 4, G).

The unusual tendencies of inflorescence structure in such species as *M. subpaniculata* and *M. xanthostoma,* differing widely in their immediate intergeneric affinities, can easily be interpreted as indicating the evolution of the simple raceme characteristic of the genus as a whole from a primitive compound type similar to the thyrse. This evidence is entirely congruous with that found in the closely neighboring genus *Forsteronia.*

In this connection, the need of an anatomical investigation of those inflorescences, superficially racemose but with more than a single bract subtending each flowering pedicel, must be indicated. In the gentianaceous genus *Coutoubea*, it has been found that the inflorescence, described by systematists as a raceme, differs from a true raceme in the subtension of each flower by three to four inconspicuous decussate bracts. Recent investigation (Woodson, 1933) has disclosed the occurrence of occasional, abortive or dormant buds in the axils of these bracts which are detectable only in microscopic preparations. The "pedicels" of this inflorescence, therefore, are anatomically determinate axes, and the "raceme" itself could more accurately be described as a greatly reduced thyrse.

Corymbose and spiciform modifications of the raceme in *Mandevilla* are illustrated by *M. callacatensis* Mgf. and *M. scabra* (R. & S.) K. Sch. respectively (text-fig. 4, A–C).

TEMNADENIA Miers

The dichotomous cincinnus is a type of inflorescence characteristic of a number of apocynaceous genera, in which the flowering axis consists of a more or less elongate, naked peduncle terminated by two bracts of various size and texture subtending roughly equal, scorpioid branches. Noting the abscence of any interpretable structure in the crotch of the two frequently divaricate branches, one might be tempted to suppose the agency of dichotomy of the young growing initials of the inflorescence in early stages of development. Such superficially "dichotomous" inflorescences as those of *Temnadenia stellaris* (Lindl.) Miers (text-fig. 5, D) may occasionally be found to produce determinate flowers in the crotch of the scorpioid branches (text-fig. 5, E), however.

The suspicion that the inflorescence of *Temnadenia* has arisen from the elimination of the determinate flower of a continuous dichasium is heightened by an examination of the inflorescence of *T. stenantha* Woods. (text-fig. 5, F), recently discovered in northern Colombia, in which some of the uppermost branches may be clearly dichasial, with pedicels and bracts regularly disposed, although with unmistakable ten-

dencies toward the cincinnus. The lower branches of this inflorescence are of the superficially dichotomous development, even to the disappearance of the subtending bracts at the dichotomy.

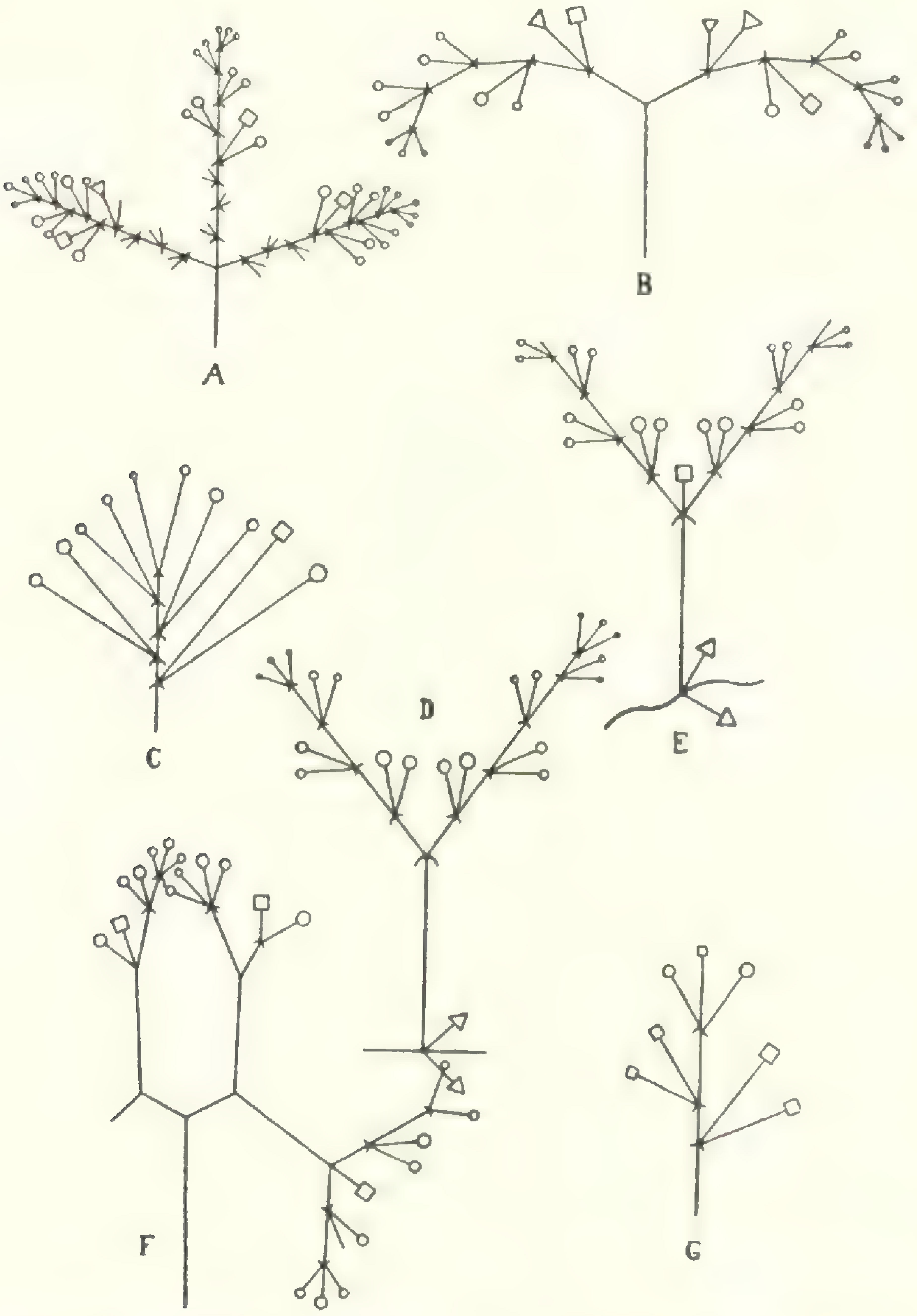


Fig. 5. Inflorescence structure: A—*Prestonia Meg'agros* (Vell.) Woods.; B—*P. portobellensis* (Beurl.) Woods.; C—*P. mexicana* A.DC.; D–E—*Temnadenia stellaris* (Lindl.) Miers; F—*T. stenantha* Woods.; G—*T. violacea* (Vell.) Miers. Explanation in the text.

The inflorescence of *T. violacea* (Vell.) Miers is usually simple and scorpioid (text-fig. 5, G), although individuals are not difficult to find in which derivation from such a floral axis

as that of *T. stellaris* is indicated by an inconspicuous subsidiary axis.

Prestonia R. Br.

The genus *Prestonia*, consisting of approximately fifty-four known species, is largely characterized by a type of inflorescence rather puzzling in its complications. In such inflorescences as those of *P. agglutinata* (Jacq.) Woods. (pl. 3, fig. 1) of the section *Coalitae*, and *P. quinquangularis* (Jacq.) Spreng. of the section *Acutifoliae*, the axis is simple and the pedicels scorpioidally arranged. These two species are selected for illustration since they exhibit to some extent the peculiar zigzag habit of the peduncle correlated with the scorpioid inflorescence of *Angadenia Sagraei*, evidently caused by the alternate left- and right-handed modification of a primitive dichasium, to which reference has been made previously.

Such species as *P. portobellensis* (Beurl.) Woods. (text-fig. 5, B) and *P. Meg'agros* (Vell.) Woods. (text-fig. 5, A) of the section *Annulares* exhibit a conspicuous di- or trichotomy of the inflorescence. In all such instances among species of *Prestonia* bracts are virtually lacking at the place of division of the floriferous from the naked branches, by which they lose the clue to a cymose origin found in species of *Temnadenia*. There appears to be little reason to doubt such dichotomous inflorescences as that of *P. portobellensis* to have been derived from the suppression of the determinate floral member and subtending bracts as in *Temnadenia*, indicating evolution from a continuous dichasium. If that interpretation be allowed, it would appear logical to assume the modification of the trichotomous inflorescences, represented by that of *P. Meg'agros* from an ancestral aggregate dichasium, such as that of *Forsteronia* species.

The section *Tomentosae* of *Prestonia* includes numerous species varying widely in their habit of inflorescence from simple to di- or trichotomous cincinni. In general, however, the tendency of inflorescence of these species is toward the condensation of the peduncle, producing such virtual umbels or corymbs as those of *P. mexicana* A. DC. (text-fig. 5, C, in which the pe-

duncle has been unnaturally extended to clarify its composition) and *P. brachypoda* Blake. The umbellate condition is closely approached amongst the species of *Thenardia* as well, in which the floriferous branches of a condensed, aggregate dichasium as that of *T. floribunda* HBK. (pl. 3, fig. 4) become successively foreshortened until the relatively elongate pedicels have the appearance of springing from a common receptacle subtended by numerous, involucre-like bracts as in *T. Galeottiana* Baill. The remarkable umbellate cymes of the genus *Malouetia* (cf. *M. Schomburgki* Muell.-Arg., pl. 3, fig. 2) have presumably had a similar origin.

Macrosiphonia Muell.-Arg.

Reduction from a pluriflorous condition has evidently resulted in the solitary, terminal flowers characteristic of the familiar North American species of *Macrosiphonia.* Since the evidence of reduction (i. e., position and composition of bracts and frequency of occasional lateral flowers) is used taxonomically in the delimitation of species, each will be discussed briefly.

Macrosiphonia hypoleuca (Benth.) Muell.-Arg., a low, suffrutescent species of the north-central Mexican plateau, is partially characterized by the terminal inflorescence consisting usually of a large, white, vespertine flower borne upon a relatively short pedicel subtended by two rather inconspicuous, paired bracts. Below the bracts is a peduncle ordinarily of about the length of the pedicel (text-fig. 6, A). The presence of the bracts reveals the compound nature of this superficially simple inflorescence, and their paired disposition would lead us to infer modification from a primitive cyme of which the present solitary flower might logically be viewed as the surviving determinate member.

Happily for this view specimens are not rare in which a second flower is found accompanying the determinate flower, obviously in the axil of one of the subtending bracts. An occurrence much less common is the formation of a complete three-flowered cymule (text-fig. 6, B). In at least one instance, however, a specimen from southern Mexico has been found in

which the appearance of a three-flowered raceme has been produced, presumably by the translocation of the normally opposite nodes.

Macrosiphonia Macrosiphon (Torr.) Heller differs from *M. hypoleuca* largely in the conspicuously foliaceous calyx-lobes, more or less petalaceous in the latter, and the broader, nearly concolorous leaves, which are conspicuously paler beneath in *M. hypoleuca.* The inflorescence of *M. Macrosiphon* also differs radically from that of its neighboring species, in the preponderant number of specimens examined, by the pedicel of the terminal flower becoming virtually sessile through the re-

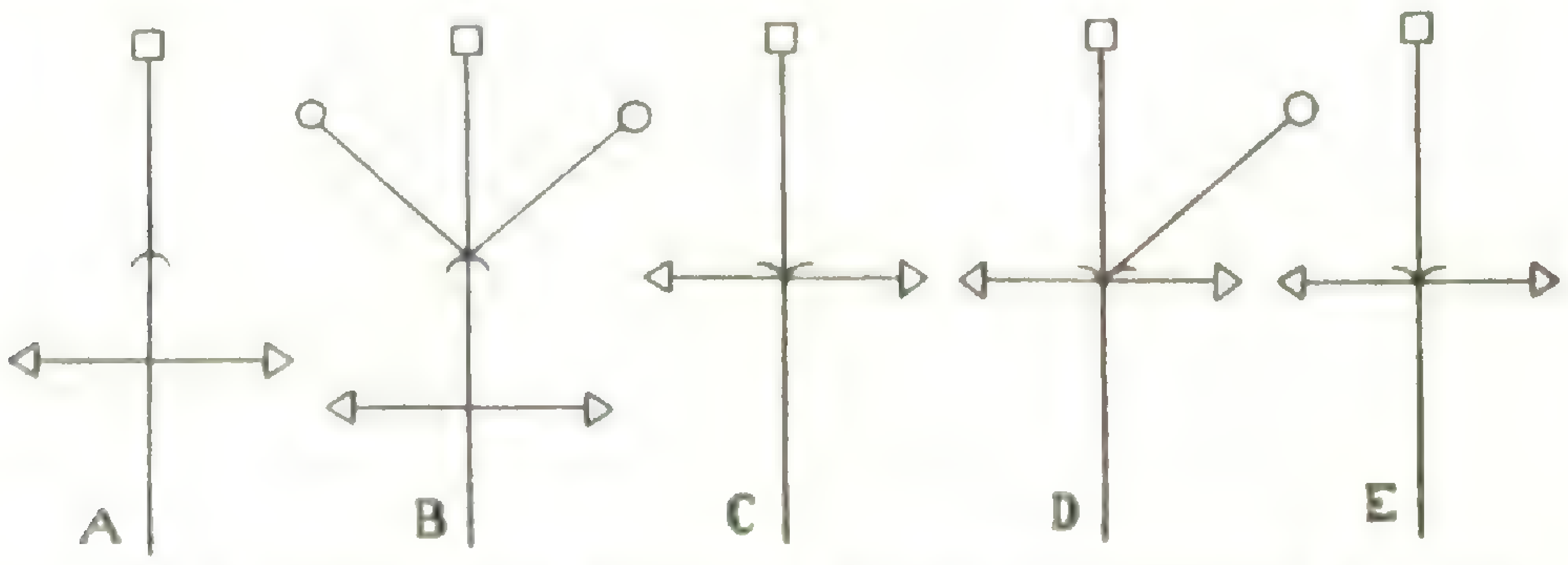


Fig. 6. Inflorescence structure: A–B—*Macrosiphonia hypoleuca* (Benth.) Muell.-Arg.; C—*M. Macrosiphon* (Torr.) Heller; D–E—*M. Brachysiphon* (Torr.) A. Gray. Explanation in the text.

duction of the peduncle (text-fig. 6, C). The primitively compound inflorescence is scarcely recalled save by the subtending, paired bracts which remain. These also may virtually disappear. No instances have been observed in which floral members have been formed in the axils of the bracts. The appearance of a perfectly simple, terminal flower in this species through reduction evidently depends upon the impending elimination of the already inconspicuous floral bracts. *Macrosiphonia Brachysiphon* (Torr.) A. Gray and *M. Hesperia* I. M. Johnston have been collected with both one and two flowers constituting the inflorescence (cf. *M. Brachysiphon,* text-fig. 6, D–E), which is practically devoid of a peduncle in either.

The opinion has been expressed elsewhere (Woodson, 1930) that the North and South American species of *Macrosiphonia* may have had independent derivation from some common stock such as that of the large and widespread genus *Mandevilla* or

its primitive progenitor. This conjecture receives support in the structure of the inflorescence of either group. That of South American species may be composed of either few or solitary flowers, which is somewhat less common. When few flowers occur, as in *M. longiflora* (Desf.) Muell.-Arg. (pl. 3, fig. 5), they appear in racemose disposition. Immediately subtending the calyx-lobes, however, is always observable a cluster of bracts which would indicate derivation from such a compound floral axis as that of the thyrse, for example. It has been pointed out previously that the mode of inflorescence in *Mandevilla* may be supposed to have been derived from a thyrse.

Additional instances in which a multiplicity of bracts supposedly remnant from a pluriflorous inflorescence is observable directly subtending a solitary flower borne in a lateral position are illustrated by *Elytropus chilensis* (A. DC.) Muell.-Arg. and *Macropharynx spectabilis* (Stadelm.) Woods. Specimens of either have been found in which one or two supernumerary floral members have been developed.

Vinca L. and Lochnera Rchb.

Vinca minor L. and *Lochnera rosea* (L.) Rchb. are among the most familiar garden plants. The former, popularly known as "running myrtle," is supposedly indigenous to the northern Mediterranean area, but has been so widely and so easily cultivated that it has become naturalized over a large part of western Europe and temperate North America. The latter, known as "periwinkle," has so successfully colonized the tropics of both hemispheres that considerable doubt surrounds the whereabouts of its original home, although it is probably from the Old World, the provenience of the two remaining species of the genus. A tender, ever-blooming annual, it forms an almost indispensable bedding plant in parks of the United States.

The inflorescence of *V. minor* (text-fig. 7, C) consists of solitary, lateral flowers. It is interesting to note, further, that the flowers appear only upon the semi-erect shoots produced in the early spring and summer from the creeping, perennial stolons. Not all the leaves of such shoots subtend flowers. The flowers

of *L. rosea* are produced regularly in lateral pairs subtended by the foliage leaves (text-fig. 7, A). The pedicels are arranged radially with respect to the stem axis and the subtending leaf; and the central flower always expands first. As the leaves are decussate, pairs of flowers are in nearly all cases found in the axil of only one of the paired leaves, ascending the axis spirally. It is clear that the axis of the inflorescence of *L. rosea* is a sympodium derived from a cincinnus.

Among many flowering individuals of *L. rosea* occasional abnormalities are found in which only a single flower is formed in the axil of a subtending leaf (text-fig. 7, B). Considering the very close relationship of the genera *Vinca* and *Lochnera*, it

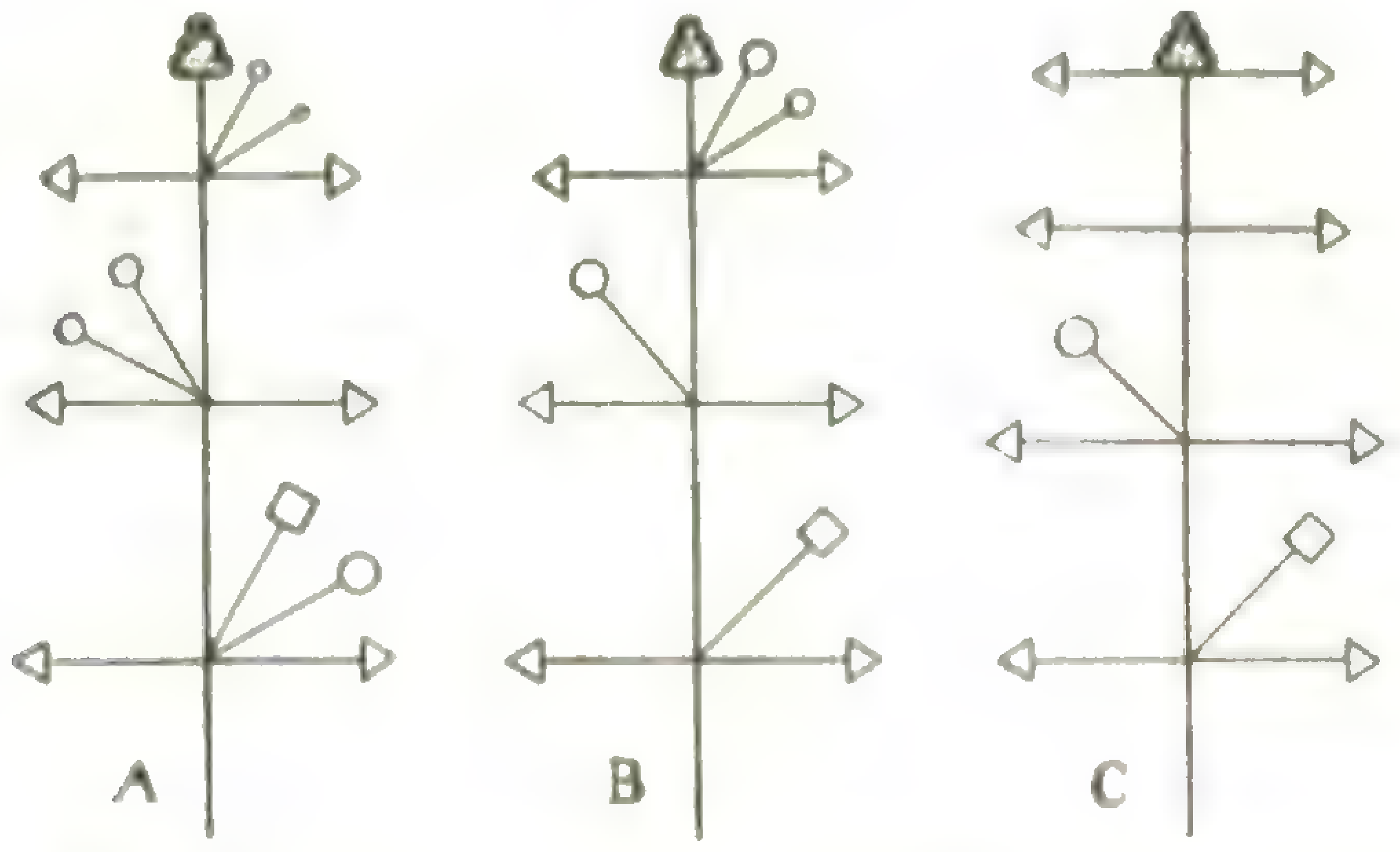


Fig. 7. Inflorescence structure: A–B—*Lochnera rosea* (L.) Rchb.; C—*Vinca minor* L.

seems more than likely that the indeterminate flowering axis of the former, bearing solitary, lateral flowers in spiral fashion, should represent derivation from such a sympodial axis as that of the latter.

Discussion

The necessity of a general review of literature concerning the inflorescence is obviated by the very full historical account given by Parkin (1914), whose admirable treatment of the evolution of the inflorescence remains our most comprehensive. In view of the great importance of that memoir and of the somewhat different conclusions to which the present writer has arrived, it would doubtless be both appropriate and serviceable to combine a discussion of the apparent evolution of the inflorescence in Apocynaceae with a rather extended criticism

of the views so ably expressed by Parkin. In introduction, it is scarcely possible to recall too forcefully that this writer's opinions are based upon observations within a wide range of a single family. Although intensive study within a single natural group, even though large, entails indubitable benefits, it can scarcely be said to result in conclusions which are applicable to all groups equally. This will become apparent in a subsequent paragraph. On the other hand, it rarely happens that a general biological principle, such as that influencing the modification of the inflorescence, can be true of a single natural group, and of none of its closely neighboring relatives.

In his study of the inflorescence herbarium specimens were virtually ignored by Parkin upon the assumption of imperfect evidence offered by them. However, recourse was had to a large number of living plants selected from species commonly cultivated in English gardens. Special emphasis was placed in this selection upon dicotyledonous representatives of the so-called "primitive alliances," such as Magnoliales, Ranales, Papaverales, etc. Evidently inspired by the frequent occurrence of solitary, terminal flowers in plants belonging to such orders of established antiquity, Parkin was led to conclude that in the primitive inflorescence "flowers were originally borne in a solitary fashion, and that the clustering of them together without intervening foliage is a later development." Upon this assumption, he quoted the familiar Euclidean "reductio ad absurdum" to dispel Church's interpretation of the solitary flower of *Pyrus Cydonia* as a reduction from the many-flowered inflorescences of such species as *P. Aucuparia* (Church, 1908).

Parkin's statement that the solitary, terminal flower is an ancient structure approaches the platitudinous when one reflects that the flower itself may be defined as a highly specialized, contracted short shoot bearing a collection of sporophylls with or without an accompanying envelope. Quite likely, through past ages isolated progenitors of the modern Angiospermous flower, occurring terminally and isolated by intervening foliage, became aggregated to form a specialized branch system coincident with the evolution of the flower itself. But to trace the very foundations of the evolutionary development

of the inflorescence among the extant Angiospermae is a dangerous undertaking none the less. No doubt the floral organization of the Ranunculaceae may be considered as "primitive" from several points of view, but few would extend that interpretation to the herbaceous habit so conspicuously predominant in the family. Similarly, although *Papaver* is clearly a genus of great antiquity, we would be slow to describe its gynoecium as "primitive" or elemental. It should clearly be recognized that groups of plants may possess palingenetic and cenogenetic characters side by side; our recognition of the former should not confuse our interpretation of the latter, although not to do so is manifestly difficult at times.

In supporting his contention of the primitive nature of the solitary, terminal flower among Angiosperms, Parkin cited the existence of terminal strobili in the Bennettitalean-Cycadalean plexus, now generally assumed to represent a primordium from which the flowering plants may have evolved. He noted, however, that the solitary, terminal strobili of the Cycads are occasionally accompanied by supernumerary members at the stem apex. The continuation of the vegetative growth is accomplished by a lateral bud, and a sympodium results. The anatomy of the axis of Cycads discloses the existence of a telescoped[1] sympodium essentially cymose in its composition, as Miss Smith (1907) has pointed out. In the Bennettitales, also, the branching of the Triassic *Williamsonia (Anomozamites) angustifolia* (Nathorst, 1902) and the Jurassic *Wielandiella* is of the sympodial type. The branching axis of the former, consisting of a system of relatively slender stems terminating in a strobilus surrounded by a rosette of leaves below which two equal branches are found similarly compounded, bears an unmistakable similarity to the modern dichasium of Angio-

[1] Apparently A. P. De Candolle (1827) was the first to use the metaphor of the telescope in describing extension and condensation of axes: "Je me ferais peut-être comprendre plus complètement par une métaphore bien grossière: supposons une branche florale organisée comme une lunette d'approche, qui porterait un pédicelle au haut de chacun des tubes qui la composent: que tous les tubes soient déboîtés et alongés, vous aurez une grappe; repoussez ces tubes à moitié, ce sera encore une grappe, mais très-courte; rentrez-les complètement, et vous aurez une ombelle terminale.

sperms, and the resemblance would appear to be more than fortuitous. It would appear a fruitless task to search for the earliest indications of the inflorescence among the extant flowering plants: the origin of the inflorescence is at least as remote as the origin of the flower, and a greater antiquity seems probable from the evidence of paleobotany.

Development of the pluriflorous inflorescence from the solitary, terminal flower is accomplished according to Parkin by the appearance of subordinate, lateral flowers literally "pushed out" of the axils of the subtending leaves of the original, terminal floral member. The continual "emitting" of subordinate flowers forms the first type of compound inflorescence: the dichasium. This process is illustrated in the genus *Papaver* by such species as *P. Rhoeas, P. strictum,* and *P. pilosum* in a series of floral accumulation, as we might express it for want of a better term.

The naivety of this conception of floral "emission" is heightened by the causal agent, ascribed by Parkin (1914) with some qualification to "a superabundance of reproductive material, more than the shoot could utilize in the formation of a single flower." This somewhat feeble effort to drag the continuity of the germ-plasm into the discussion of the inflorescence serves to illustrate rather indirectly the perplexing fact that although much is known concerning the "geometry" of plants, little indeed is understood of the causal mechanism responsible for it. Our easiest task, consequently, is to express structural modifications of plants in terms of the geometrical pattern approaching more nearly universal application throughout specific, natural groups. One might cite the example of dichasial branching, which is infinite in its theoretical extension. Practically, however, certain internal and external factors limit the expression of the dichasium to a definite numerical range of floral members in one species, and to a slightly different range in another.

In the end, the morphologist finds in nearly any highly developed group a "reduction series" in evolutionary history much easier to read than an "ascending series." Time and again the morphologist has found himself deceived by the ap-

parent "simplicity" of species and genera which have suffered reduction from the more elaborate geometrical pattern of their relatives during the inscrutable course of evolution. It should not be necessary to recall that our modern flowering plants represent a very ancient and specialized development whose foundations are still, and possibly always will be, exasperatingly obscure. The so-called "primitive alliances" are evidently scarcely more ancient, from available paleobotanical records, than others from which they have been separated by the imposition of an imperfect system of classification. The herbaceous habit of such genera as *Papaver*, for example, might be cited as but one evidence of a long and specialized evolutionary development.

From the evidence briefly reviewed for *Echites umbellata*, the evolution of the uniflorous condition from pluriflory through the agency of reduction appears plausible, for we have the evidence of reduction at hand in the form of "empty" bracts and occasional abortive buds. The opposite assumption, which would logically include the inference that such buds are in a nascent stage, would appear preposterous. This writer finds ample sympathy for the independent and earlier views of Church (1908) respecting the evolution of the inflorescence in *Pyrus* to which reference has been made in a preceding paragraph.

The result of reduction upon the development of the remaining floral members of the inflorescence described in the previous paragraph is strikingly similar to that of the old horticultural practice of "picking out the suckers," or "disbudding," in the cultivation of tomatoes, grapes, and other cultivated plants, by which the growers seek to influence the subsequent development of the remaining members. "Disbudding" is also practiced in the forcing of cultivated chrysanthemums, etc., and the time of blooming can be controlled largely through this agency. Gardeners using the same method in the cultivation of such plants as *Paeonia* have observed that plants which "disbud themselves," e. g., by natural abortion of floral buds, bloom earlier and have larger flowers than those whose full floral complement develops unchecked.

Much the same effect can be produced experimentally by amputating floral buds of such an inflorescence as the multiflorous thyrse of the apocynaceous *Amsonia Tabernaemontana* Walt. Precaution must be taken, however, to arrest the development of the buds at a sufficiently early stage and with the slightest possible injury. All experiments made in this manner have not been wholly satisfactory, due probably at least in part to the latter factor. Since it is impossible wholly to exclude the factor of injury, even slight success in modifying the symmetry of the cyme may be regarded as significant, the more subtle influence of natural abortion being beyond perfect imitation.

Concerning the transition of the indeterminate from the determinate inflorescence, Parkin (1914) envisions a process in which "the number of lateral floral shoots increase, so that the main terminal flower no longer blooms first. The flowers then tend to open in acropetal succession from the commencement. The next step comes about through the flower-buds of the uppermost part of the inflorescence never expanding; this part, in fact, becomes arrested in its development and finally aborts, leaving a mere filament or protuberance in its place. In this way the original terminal flower disappears. The inflorescence is now racemose." In the light of what the author has said as previously reported concerning the supposed primitive, few-flowered inflorescence, one can scarcely avoid confusion in attempting to harmonize this last statement with the innumerable-flowered cymes of *Statice* and the relatively few-flowered racemes of *Plumbago* among Plumbaginaceae, to cite only one example. From Parkin's statement one would be justified in expecting racemes to contain more numerous flowers than cymes. Such is scarcely the case. The flexibility of the extent of the cyme might be likened in potentiality to that of the compound interest table.

On the other hand, failure of the apex of the peduncle to produce a terminal flower is not an inalienable characteristic of the raceme. In racemes of but few flowers a terminal member frequently occurs. This has already been demonstrated for the genus *Mandevilla* of the Apocynaceae (cf. text-fig. 4, A–G).

In perhaps no other particular are the observations of Parkin and those of this writer in greater contrast than in the immediate agency involved in the transformation of the indeterminate from the determinate mode of inflorescence. Both views are based upon anatomical-physiological assumptions. The view of Parkin may be epitomized in the statement that as the lower floral members increase in number, the development of the apical members is hindered by the increasing demands upon the conductive facilities of the axis, supposedly. In the preceding observations among the Apocynaceae, on the other hand, a totally different process is adduced. It has been found in *Echites* that in the instance of two equivalent cymules of identical composition the *reduction* of one or more floral members of one will hasten the development of the other component members, thus effectively disrupting the characteristic "symmetry" of the two equivalent cymules. It has been inferred with ample evidence that the cincinnus and the bostryx have evolved from the dichasium in this family through the reduction of a whole cymule to a solitary flower, thus invariably hastening its development second only to the primary determinate flower with which it becomes associated.

It is understood that reduction has effected *one* of the lateral cymules of a continuous dichasium to the production of the cincinnus or the bostryx. The effect of the reduction of *both* lateral cymules of an aggregate dichasium may be computed artificially: its demonstration in nature is afforded in the large genus *Forsteronia*, by which it has been shown that closely related species intergrade from aggregate dichasial inflorescences to a raceme through various modifications of the thyrse.

Having traced the development of the more important types of determinate and indeterminate inflorescences amongst the Apocynaceae, it becomes easy to extend our understanding; by the reduction of the pedicel to derive the spike from the raceme, and by the reduction of the peduncle and the compensating elongation of the pedicel to produce the corymb and the umbel, which may evidently be derived from both determinate and indeterminate forebears. Although generalizations are fre-

quently weak in the face of detailed attack, it may be permitted to visualize the writer's conception of the evolution of the fundamental types of inflorescence in Apocynaceae as represented in text-fig. 8.

At this juncture prominence should be given to the fact that reduction of floral members does not always hasten the de-

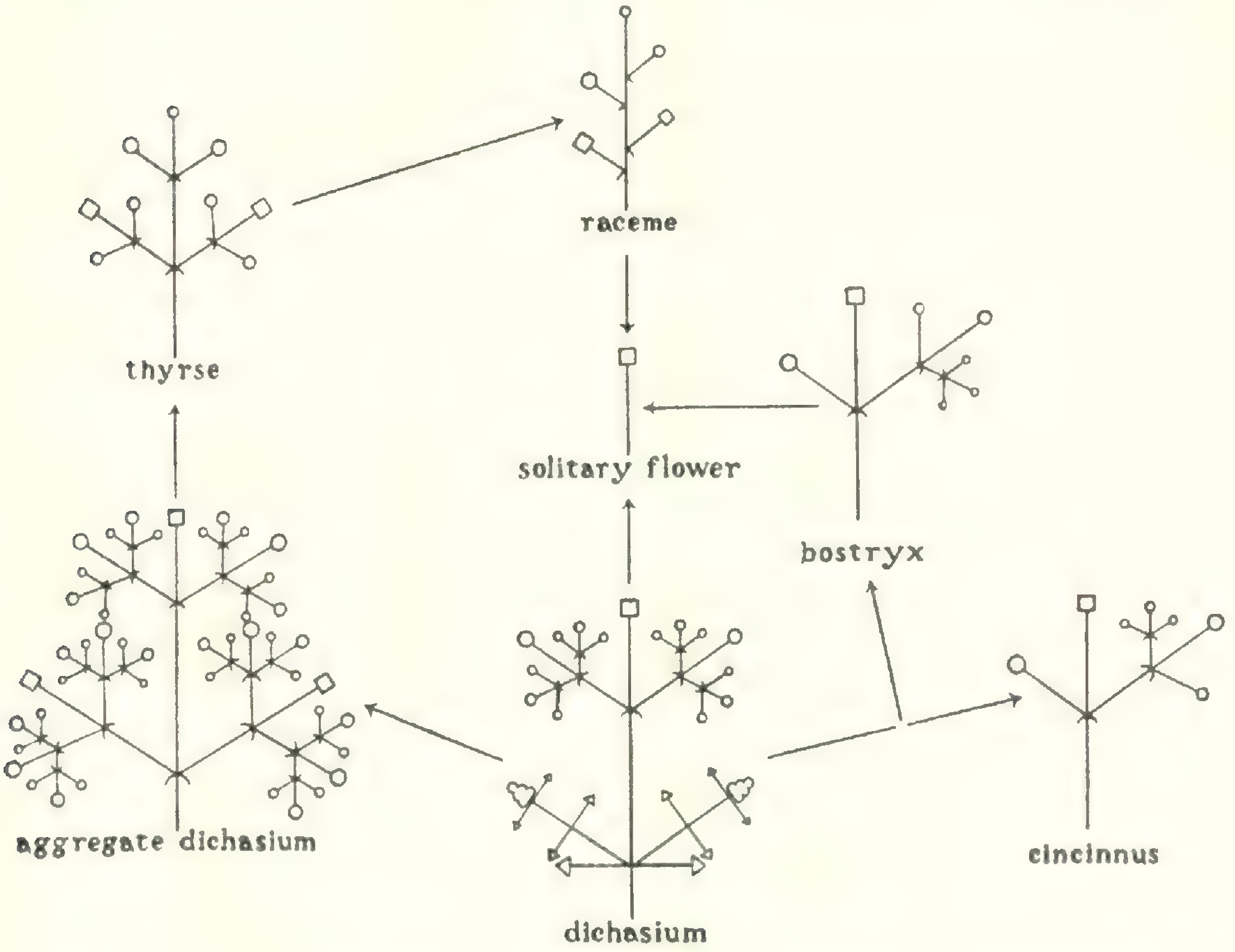


Fig. 8. Schematic diagram of the supposed relationship of certain types of inflorescence in Apocynaceae. Explanation in the text.

velopment of the remaining members of a cyme. Early in the course of these investigations recourse was had to members of other families to ascertain whether the same procedure is common. Selecting families containing familiar representatives bearing cymose inflorescences, it was soon found that the same principles discovered in Apocynaceae are apparently applicable in members of such families as Ranunculaceae, Rosaceae, Primulaceae, Gentianaceae, etc. In the family Caryophyllaceae, characterized by the predominance of the cyme, how-

ever, the principle of reduction in the disruption of cymose symmetry appears to be completely reversed. One needs but examine a colony of such a species as *Arenaria patula* to discover that the terminal flower of a somewhat reduced cymule actually blooms somewhat later than the terminal member of an equivalent, less-reduced branch. The reversal, moreover, appears widespread if not universal throughout the family, as well as in members of Convolvulaceae, and it would be odd indeed if it were unique among the flowering plants in this respect.

The solution of the enigma which is thus introduced, as well as the actual mechanism of the phenomena noted in Apocynaceae, etc., would appear to lie in a study of the anatomy of the inflorescence, a virtually untouched field since the rather few students of the inflorescence as a whole have limited themselves to gross morphology save in special instances. A decidedly hypothetical conception which must be tested by a future anatomical study of the inflorescence to explain the divergent results of reduction in Apocynaceae on the one hand and Caryophyllaceae on the other, might involve the divergent reduction of vascular tissues within the respective inflorescences: the reduction of vascular tissues and its attendant physiological effects possibly being limited to the pedicels of discarded members in Apocynaceae, thus redistributing the full flow of the conductive elements to the fewer floral members which would benefit accordingly; the reduction of vascular tissues in the Caryophyllaceae on the other hand taking place in the peduncular axes, thus hindering the development of the branch system as a whole. At any event, the primitive nature of the cyme in Caryophyllaceae should be established by future studies of the inflorescence of the group; here also, as in Apocynaceae, etc., the solitary flower is evidently a condition derived from pluriflory.

Minor points of criticism of Parkin's observations, in the light of the present writer's investigations on the inflorescence of Apocynaceae, may be dismissed without discussion. It should be noted that both are in agreement concerning the primitive nature of determinate and the derived condition of

indeterminate inflorescences. It is suspected that Parkin's inferences concerning the method by which the indeterminate mode was derived from the determinate were unfortunately affected by the fact that his illustrations include no perfectly symmetrical representatives of the latter. It is easily appreciated that the most characteristic features of the dichasium, for example, are lost in species with alternate, or spiral phyllotaxy, as has been indicated in an earlier section of this paper.

Summary

The following conclusions have resulted from a study of the inflorescence structure of numerous representatives of Apocynaceae throughout the distribution of the family, as revealed by both living and herbarium specimens. Special emphasis has been placed upon the American representatives of the subfamily Echitoideae, an evidently natural group lately studied by this writer (Woodson, 1933) from the combined aspects of floral anatomy and taxonomy.

1. The dichasial cyme appears to be the primitive inflorescence of the family.

2. The symmetry characteristic of the composition and sequence of development of equivalent cymules of the inflorescence of *Echites umbellata* Jacq. is found to be profoundly modified by unequal reduction of the component floral members. Reduction of one or more lateral members of a cyme is found to accompany a somewhat hastened development of the remaining members. This effect of reduction appears constant, or relatively so, amongst Apocynaceae and certain other families, but appears to be reversed in Caryophyllaceae (and Convolvulaceae) for reasons which are briefly conjectured. Such an agency is found to parallel long-established horticultural practices, such as "picking out the suckers," and "disbudding."

3. Reduction of a single branch of a continuous dichasium always to the right or left of the determinate flower, or to the right and left alternately, results in the production of a bostryx or a cincinnus respectively.

4. The transformation of the inflorescence from an aggre-

gate dichasium to a raceme through various modifications of the thyrse is traced amongst the species of the genus *Forsteronia.* This progression has evidently been actuated by the progressive reduction in acropetal fashion of both the decussate pairs of branches of an aggregate dichasium.

5. The spike is derived from the raceme; the corymb and the umbel are derivative from both determinate and indeterminate inflorescences.

6. Solitary flowers, whether terminal or lateral, are apparently derived from a previous condition of pluriflory through the agency of reduction.

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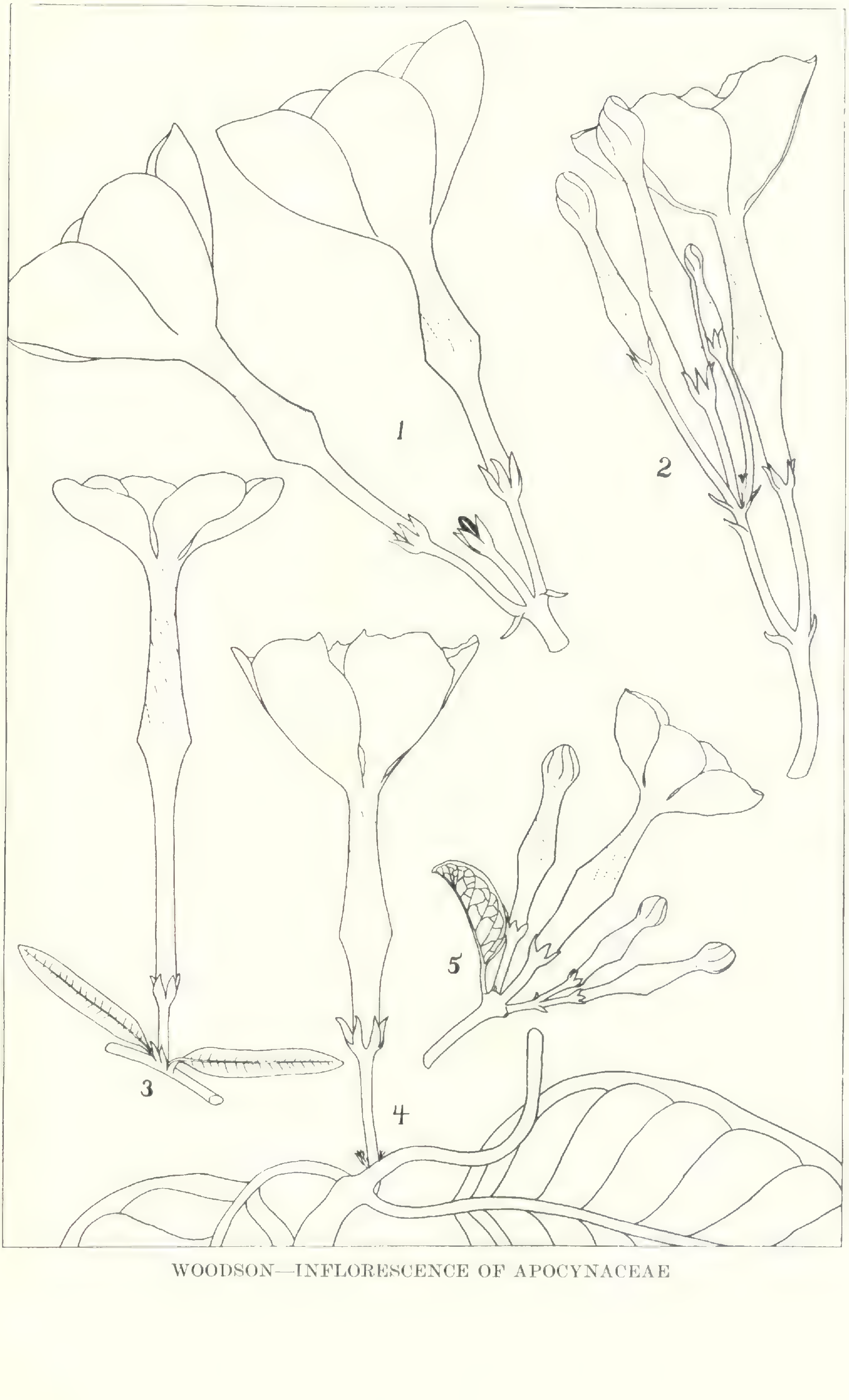
Explanation of Plate

PLATE 1

Figs. 1-2, 4-5. Variation in inflorescence structure amongst individuals of *Echites umbellata* Jacq.

Fig. 3. Inflorescence structure of *E. crassipes* A. Rich.

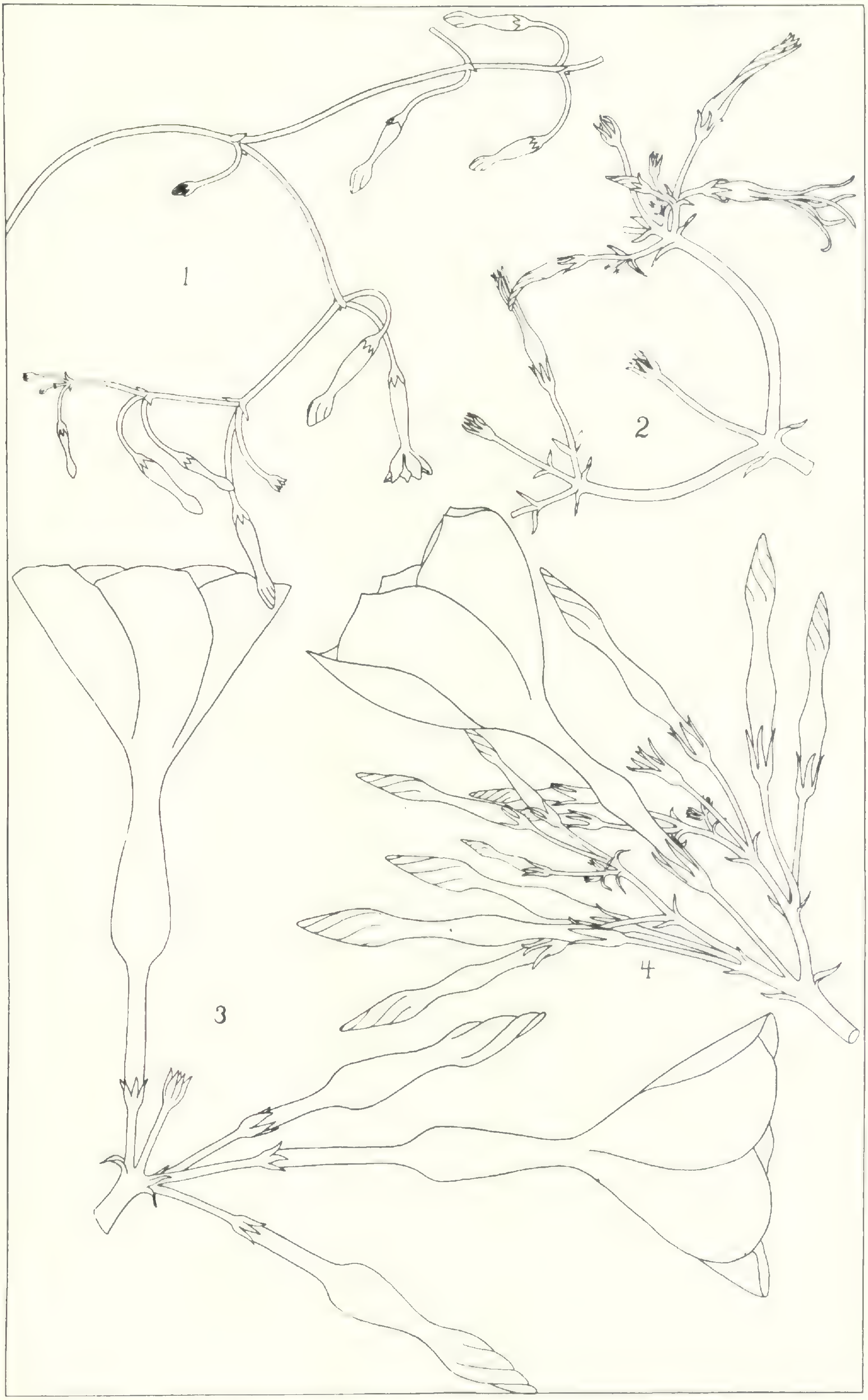


WOODSON—INFLORESCENCE OF APOCYNACEAE

Explanation of Plate

PLATE 2

Fig. 1. *Echites tuxtlensis* Standl.
Fig. 2. *E. turbinata* Woods.
Fig. 3. *E. yucatanensis* Millsp.
Fig. 4. *E. turrigera* Woods.



WOODSON—INFLORESCENCE OF APOCYNACEAE

Explanation of Plate

PLATE 3

Fig. 1. *Prestonia agglutinata* (Jacq.) Woods.
Fig. 2. *Malouetia Schomburgki* Muell.-Arg.
Fig. 3. *Fernaldia pandurata* (A.DC.) Woods.
Fig. 4. *Thenardia floribunda* HBK.
Fig. 5. *Macrosiphonia longiflora* (Desf.) Muell.-Arg.

WOODSON—INFLORESCENCE OF APOCYNACEAE

A NEW KALLSTROEMIA FROM TEXAS

LOUIS WILLIAMS

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Kallstroemia hirsuta n. sp.[1] Ascending or erect annual, 1–2 dm. high; stems 1–several from the base, densely hirsute and strigose-pubescent, the hirsute hairs with pustulate bases; leaves 2–4.5 cm. long, oblong to ovate-oblong, petiolate, densely hirsute and strigose-pubescent on both surfaces, the petiole about as long as the lower pair of leaflets; leaflets 3–6 pairs, sessile, obliquely oblong or ovate, 7–14 mm. long, 3–8 mm. wide, obtuse or acute, about equal in size, the terminal more oblique; stipules lance-oblong, 3–4 mm. long, 1–1.5 mm. wide; calyx-lobes linear to linear-lanceolate, 10–13 mm. long, 1.5–2.5 mm. wide, hirsute and strigose-pubescent on the outer surface, the chartaceous margins inrolled in fruit; petals about 5, deltoid-ovate, 18–23 mm. long, probably white or yellowish, not marcescent; fruit compressed-oval in outline, 8–10 mm. wide, 5–6 mm. high, outer surface of carpels not tuberculate but the median portion and the two edges prominent and connected by transverse ridges, densely hirsute, particularly on the raised portions; persistent style or beak 8–10 mm. long, hirsute at the inconspicuously swollen base, stigmatic portion 1.5–2 mm. long, furcate.

Texas: Langtry, Valverde County, May, 1913, *C. R. Orcutt, 6126* (Mo. Bot. Gard. Herb.) type.

This species is most closely allied to *K. grandiflora* Torr., from which it may be separated by the following characters: the entire plant is densely pubescent with hirsute and strigose

[1] **Kallstroemia hirsuta** sp. nov. Annua 1–2 dm. alta, dense hirsuta et strigoso-pubescente; foliis oblongis aut oblongo-ovatis utrinque pubescentibus; foliolis 3–6 paribus, sessilibus, 7–14 mm. longis, 3–8 mm. latis; stipulis lanceolato-oblongis, 3–4 mm. longis, 1–1.5 mm. latis; lobis calycis linearibus vel lineari-lanceolatis, 10–13 mm. longis, 1.5–2.5 mm. latis; petalis ca. 5, deltoideo-ovatis, 18–23 mm. longis; carpellis non tuberculatis parte medio et marginibus prominentibus; stylo 8–10 mm. longo, ad basem hirsuto.

Issued March 25, 1935.

hairs intermixed; the carpels are not tuberculate on the outer surface nor merely equally strigose but have the median portion and the outer edges raised and these connected with transverse ridges, and especially the raised portions hirsute with a small amount of strigose pubescence intermixed; beak hirsute at the base only instead of strigose nearly to the stigmatic portion.

EXPLANATION OF PLATE

PLATE 4

Kallstroemia hirsuta Williams. From the type specimen, *Charles Russell Orcutt, 6126,* in the Missouri Botanical Garden Herbarium. ⅔ natural size.

WILLIAMS—KALLSTROEMIA HIRSUTA

A CRITICAL STUDY OF CERTAIN EPAPPOSE GENERA OF THE HELIANTHEAE-VERBESININAE OF THE NATURAL FAMILY COMPOSITAE[1]

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Introduction and Acknowledgments

This paper endeavors to present the results of a study of certain epappose genera of the tribe Heliantheae-Verbesininae of the natural family Compositae. The genera *Balsamorhiza, Zaluzania, Greenmaniella, Iostephane, Echinacea,* and *Ratibida* have been dealt with, first, with regards to their comparative morphology and probable phylogenetic relationships, and second, from a taxonomic point of view. The other genera which are occasionally referred to have been studied only for their phylogenetic and generic relationships. The more closely related of these genera, and especially the epappose ones, are included in the generic key.

The writer takes this opportunity to express his appreciation and gratitude to those who have made this work possible. Particularly is he under obligation to Dr. George T. Moore for the facilities of the herbarium and library of the Missouri Botanical Garden. Sincere appreciation is hereby expressed to the curators of the various herbaria from which specimens have been borrowed, thus making this study possible. He is also indebted to Miss Nell C. Horner, Librarian, for assistance in bibliographical matters. Especial gratitude is due Dr. J. M. Greenman, under whose direction and supervision this work has been carried out, for ready and helpful suggestions given throughout this study.

[1]An investigation carried out at the Missouri Botanical Garden in the Graduate Laboratory of the Henry Shaw School of Botany of Washington University, and submitted as a thesis in partial fulfillment of the requirements for the degree of doctor of philosophy in the Henry Shaw School of Botany of Washington University.

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Part I. General Discussion

COMPARATIVE MORPHOLOGY

The genera previously mentioned, as well as *Dracopis* and *Rudbeckia,* will be here contrasted and compared. The chief distinctions are found in the involucre, the receptacle and pales, the corollas, and the achenes. The achenes and corollas present the characters of major importance in the generic differentiation.

Involucre.—The involucres of the genera studied are so uniform that it would be rather difficult to recognize any one of these genera on this character alone. The variations, however, do fall into five distinct categories: (1) the *Ratibida-Dracopis* type; (2) the *Rudbeckia-Echinacea* type; (3) the *Balsamorhiza-Iostephane* type; (4) the *Zaluzania* type; and (5) the *Greenmaniella* type.

The bracts of the involucre of *Ratibida* and *Dracopis* are so similar that it would be impossible to separate them on form alone. They are biseriate, the outer series linear, reflexed or spreading, herbaceous, and two to three times longer than the inner. Those of the inner series are about as long as the pales, but they are more herbaceous in texture, have acute apices, and a plane surface. The pales are conduplicate and marked by a brownish resin duct along each margin. The character of the involucre would be sufficient to separate these genera from those that follow.

The *Rudbeckia-Echinacea* type of involucre is of little importance in generic differentiation. The bracts are two- to three-seriate, herbaceous, linear to linear-lanceolate, and more or less spreading or reflexed. The series are of about equal length, thus differing from the *Ratibida-Dracopis* type. In *Echinacea* the inner series is attenuated and often shows a transition into the pales, as exemplified in *E. paradoxa.*

The involucres of *Balsamorhiza* and *Iostephane* differ from those of the other genera studied in that the outer series of bracts is usually much larger than the inner series. The bracts often become foliaceous and extend beyond the disk, a condition which reaches its greatest degree of development in *Bal-*

samorhiza Bolanderi, *B. deltoidea*, and *B. macrolepis*. Chrysopetala, a subgenus of *Iostephane*, is an exception, its involucre being of the helianthoid type. There is so much variation in the size of the bracts in this type that the character is of value only in specific diagnosis.

In *Zaluzania* the bracts are two or three seriate, and are graduated but never exceed the disk in length. The outer series is herbaceous, while the inner series often becomes subherbaceous or subcoriaceous, but not membranaceous. The involucre in this genus is of little value for specific characters.

The involucre in the genus *Greenmaniella* is similar to that of *Zaluzania* but in the former the bracts of the inner series are distinctly membranaceous and marked by six or more conspicuous brownish-resinous parallel nerves. This character is also present but less pronounced in the outer series. The membraneous nature of the inner involucral bracts, as well as the pales, presents a character by which these two genera may be readily distinguished.

The Receptacle and Pales.—The pales (bracts of the receptacle) are quite similar in all the genera studied and of little importance in generic differentiation; hence they may be discussed as a part of the receptacle rather than treated separately. The form of the receptacle falls into three categories, namely, (1) the columnar; (2) the conical; and (3) the broadly convex.

The columnar type of receptacle is typified in *Ratibida*, *Dracopis*, and also in the Laciniatae, Heliopsidae, and Laevigatae sections of the genus *Rudbeckia*. It reaches its highest degree of development in *Rudbeckia maxima*, where it often attains a length of 5 cm.; the maximum length in *Ratibida* is 3 to 3.5 cm., as in *R. columnaris* and *R. peduncularis*. In *Ratibida* and *Dracopis* the receptacle is narrowly cylindrical from the base upwards, whereas in *Rudbeckia* it becomes broadened somewhat towards the base. In *Ratibida* and *Rudbeckia* the pales are deciduous from the receptacle after maturity, this being more pronounced in *Ratibida*, and they are bordered along each margin by a large elongated brownish or purplish

resin duct. In the columnar sections of *Rudbeckia* the pales are absent, or if present represented by fine brownish lines.

Echinacea, Iostephane, Zaluzania, Greenmaniella, and a majority of the species of *Rudbeckia* fall into the second category with conical receptacles. The maximum development is attained in *Echinacea* and the subgenus Euiostephane of *Iostephane*. The receptacle in *Echinacea* is elongated, 1–1.5 cm. high. In Euiostephane the receptacle is also conical, but the head appears hemispherical, due to the outer pales being longer than the inner. The pales of the two latter genera are stout and terminate in straight or slightly curved spiny tips. This is more pronounced in *Echinacea,* where the stout slender spiny tips extend beyond the corollas, thus giving the head an echinate appearance. The pales of *Zaluzania* are without characters of any generic significance, but the pales of *Greenmaniella* are thin and membranaceous and marked by several brownish parallel veins, a type of pale rather unusual for the Verbesininae.

Balsamorhiza is characterized by a broadly convex receptacle, a type also characteristic of *Wyethia,* a pappose genus of the Verbesininae. In both of these genera the heads are very large and so very similar that for one not familiar with the two genera it is necessary to examine the achenes before one is certain as to the genus. The large broadly convex receptacle of *Balsamorhiza* may distinguish it from other epappose genera of the Verbesininae.

Corollas.—The ray-flowers are of two types, styliferous, as in *Balsamorhiza, Greenmaniella,* and *Zaluzania,* or without styles, as in *Echinacea, Dracopis, Iostephane, Ratibida,* etc. This difference, since it is a constant character and since it results in either fertile or sterile achenes of the ray-flowers, serves as a major factor in separating these genera into two main divisions. The lamina and tube present no marks of generic importance. The rays are present in all the species of these genera except *Zaluzania discoidea, Z. Pringlei,* and *Balsamorhiza invenusta,* and here the characters of the achene and disk-corolla are sufficient to identify the genus. In these

genera the ligules are commonly yellow. In *Echinacea* and *Iostephane* the rays in the majority of the species are purple, but in *Ratibida* they are often dark purple blotched at the base.

The form and size of the disk-corollas are very uniform for each genus and present good generic characters in a majority of cases (pl. 5), but they are of minor importance for species characters. Two main groups may be recognized: (1) disk-corollas with a narrowly constricted tube which expands above into a broad tubular or tubular-campanulate throat and the 5-lobed limb; and (2) disk-corollas without a definite tube.

Balsamorhiza, Greenmaniella, Dracopis, Iostephane, and *Zaluzania* fall within the first group. *Zaluzania* differs from these genera in that the base of the tube is expanded so as to completely cap the crown of the achene. This and the epappose achenes and the styliferous ray-flowers are the outstanding characters of the genus. This type of disk-corolla is also found in a few species of *Viguiera.* A major difference between *Greenmaniella* and *Zaluzania* is also found in the base of the corolla-tube. In the former the base of the tube is narrow and seated inside the cup-like crown of the achene. The lower portion of the throat of the corolla in *Balsamorhiza* and *Dracopis* is often enlarged somewhat on one side, but this varies so as to be of little generic or specific importance.

Echinacea and *Ratibida* belong to the second group. The disk-corolla in *Echinacea* is enlarged at the base into a bulb-like structure which contracts above into the cylindrical, 5-lobed corolla-tube. The stamens are attached near the swollen base of the corolla. *Ratibida* differs from *Echinacea* in that the corolla is narrowed slightly at the base and then expands above into the inflated corolla-tube. The stamens, as in *Echinacea,* are also attached near the base of the corolla.

The anthers and style appendages conform to those of the Verbesininae.

Achenes.—The achenes are relatively uniform in each genus included in this study. The ray-achenes are trigonal, but in *Echinacea, Ratibida,* and *Rudbeckia* they are never fully enough developed to be of any taxonomic importance. In

Zaluzania mollissima, Z. subcordata, and *Z. augusta* the pappus of the ray-achenes furnishes useful supplementary characters in the key to the species.

The disk-achenes are more or less characteristic for each genus (pl. 5). Comparative studies are based on (1) the outline in transverse section, and (2) the nature of the crown of the achene. The general types of outline are terete, rhomboidal, and quadrangular. The majority of the genera fall in the two latter categories. The pappus, when present, is very rudimentary in comparison with that found in other Heliantheae. It varies from a toothed crown in *Echinacea,* two awn-like teeth in *Ratibida,* to the shallow cup- or disk-like crowns in *Dracopis* and *Greenmaniella.*

Dracopis is characterized by a small, black, terete, linear-cuneate achene which is minutely striated and conspicuously transversely wrinkled. The apex of the achene is bordered by a minute, brownish, disk-like crown, this type being particularly characteristic of the genus. These characters, however, are based upon the mature achene. The transversely wrinkled surface is demonstrated to a lesser degree in many species of *Rudbeckia.* The ray-achenes in *Dracopis* are rhomboidal, pubescent, and also shorter and thicker than those of the disk; the crown also has a more pronounced cup-like pappus than the disk-achenes.

The achene of *Greenmaniella* also approaches the terete type of outline. In transverse section it is broadly subangulate to subterete at maturity. In longitudinal outline it is subfusiform, that is, the broadest part is in the upper half, from which it narrows gradually towards the apex and the base. The achene is terminated by a shallow cup-like pappus with knob-like projections at the angles. The achenial character is of generic importance, since it is quite unlike those of other genera with fertile ray-flowers.

In *Echinacea, Iostephane,* and *Zaluzania* the achenes have a general rhomboidal outline in transverse section. The achene of *Zaluzania* is capped by the expanded base of the corolla-tube, and as a result no pappus is ever present, a character which

readily distinguishes this genus from all others in this study. In *Iostephane* the achene is slightly rounded at the point of insertion of the corolla. A pappus is normally absent, but if present it is represented by one or two minute paleaceous setae. The achene in *Echinacea* terminates abruptly in the jagged and toothed border surrounding the concave depression at the summit where the bulbous base of the corolla is seated. The angle facing the subtending pale has developed an elongated tooth in a majority of the species.

The achenes of *Ratibida* differ from those of the other genera in being laterally flattened or compressed-rhomboidal. In the former type, which is the more common, the pappus is composed of two awn-like teeth on each edge of the achene. The flattened edges are also more or less winged, as in *R. peduncularis.* The latter type of achene is less compressed and without a pappus, as in *R. pinnata* and *R. mexicana.*

Balsamorhiza differs from the above genera in that the achenes are from 6 to 8 mm. long and quadrangular in cross-section. Their length is two to three times that of the average achene, which, with the quadrangular outline and the absence of a pappus, is sufficient to distinguish the achenes of this genus from any other epappose genus of the Verbesininae.

PROBABLE PHYLOGENY

A discussion of the evolutionary development of this group of genera, as of any large group of closely related genera, must be more or less hypothetical. Nevertheless, from the foregoing discussion a probable line of descent may be surmised.

The ancestral stock of *Balsamorhiza, Iostephane, Zaluzania, Ratibida, Dracopis,* and *Echinacea,* within the subtribe Verbesininae, probably has been evolved from two generic complexes, namely, the *Viguiera* complex and the *Echinacea-Rudbeckia* complex. The former complex may be defined as including those pappose genera, probably extinct, which were similar to extant genera, *Helianthus, Viguiera, Tithonia,* etc. *Balsomarhiza, Iostephane, Zaluzania,* and probably *Greenmaniella,* have been derived from this complex. The *Echinacea-*

Rudbeckia complex probably comprised plants with a more or less columnar or conical receptacle similar to the present species of *Rudbeckia, Echinacea,* etc. The ancestry of *Dracopis, Rudbeckia, Ratibida* and *Echinacea* may be sought within this complex.

Iostephane has taken its origin from a helianthoid ancestor. Its evolution has progressed along two lines, one terminating in the subgenus Chrysopetala, the other in Euiostephane. The former is more closely related to *Helianthus* in the nature of the involucre, receptacle, achenes, and the corolla. Euiostephane is less closely connected, its large conical receptacle, echinate pales, and purple rays showing a more remote relationship. It is also probably an older entity. The presence of minute setose squamellae, which is uncommon, indicates a relationship with this complex. The genus is confined to the Mexican Plateau, an old region geologically speaking.

The relationships of *Zaluzania* are with the *Viguiera* complex, but its exact ancestral stock is somewhat in question. Evidence at present points to affinities with a *Viguiera-Gymnolomia* type of ancestor. The fertile ray-flowers of *Zaluzania,* along with other evidence such as the woody or suffruticose habit, the simple entire leaves in a majority of the species, and a distribution chiefly confined to the Mexican Plateau, all point to a primitive rather than a more recent group. The herbaceous species of this genus, with lobed or pinnatisect leaves, are of more recent origin. The absence of a pappus in the disk-flowers is probably due to displacement by the dilated corolla base. This is further borne out by the presence of a pappus in the ray-flowers, in which the corolla base is not dilated.

The affinities of *Greenmaniella* are in doubt since its present position in the tribe is not certain. The membranaceous nature of the involucre and pales indicates affinities other than the Verbesininae, but the determination of its exact relationship must await the collection and study of additional material.

Balsamorhiza is closely related to *Wyethia* from which it has probably been derived. The more primitive species of this

genus, as in many species of *Wyethia,* have entire, more or less ovate, pinnate, basal leaves, with subscapose stems. These species are also more aggressive and more widely distributed. *Wyethia* has affinities with the *Viguiera* complex, but this genus is of more recent origin.

The *Echinacea-Rudbeckia* complex is confined chiefly to the United States. The following theory as to their origin, based on their geographical distribution, seems plausible. This group of genera probably evolved from a similar group of plants that originated on the Appalachian-Ozarkian Upland, a region exposed since the close of the Paleozoic. A discussion of each genus, which follows, furnishes the basis for this assumption.

Echinacea is perhaps the older of these genera. Five of its six species occur on the Appalachian-Ozarkian Upland. The two most primitive species, *E. laevigata* and *E. purpurea,* are confined to this region. *Echinacea laevigata* occurs along the uplands east of the Alleghenies from eastern Pennsylvania to Georgia. This species is uncommon within its range. *Echinacea purpurea* ranges from Georgia north and west to Kentucky, and enters the Ozarkian Upland by way of southern Illinois. These two latter species are 2 to 4 feet tall, and more or less branched with leafy stems.

Echinacea paradoxa is confined to the Ozarkian Upland and the Cretaceous uplands of eastern Oklahoma and Texas. *Echinacea pallida,* a more recent species, occurs on these uplands, and has also migrated into the surrounding prairies of more recent geological history. This species has given rise to *E. angustifolia* on the dry plains to the west, extending from the Dakotas south to western Texas. These three species are more recent, due to (1) their adaptation to a drier climate of the prairies and plains, (2) their occurrence in a more recent territory, and (3) more hispid pubescence with smaller leaves and rather low, somewhat subscapose stems. The pronounced spiny pales of *Echinacea,* the corolla with a bulbous base, unlike that of any other genus, are all probably primitive characters.

Rudbeckia and *Echinacea* have evolved from a similar ancestor, but the former is of more recent origin. The area

of present development of the later species of *Rudbeckia* extends along the coastal plain from Virginia to Texas. The center of distribution includes the Appalachian-Ozarkian Upland and the coastal region from Virginia to Texas. The epappose Hirtae and Bicolores sections of this genus are of more recent development. The species of the former section are aggressive and quite nascent.

The center of distribution of the columnar species of *Rudbeckia* extends from Alabama to the Ozarkian Upland, Texas, and westward, a few species reaching the Pacific coast. It is quite evident that *Rudbeckia* has evolved along two lines, one giving rise to the type with the columnar receptacle, the other to the type with the conical receptacles. The former has developed from the western extension of this upland, and the latter from the Appalachian region. *Dracopis* has been evolved from somewhere along the columnar receptacle branch.

The center of distribution of *Ratibida* is in the region of Nebraska, since its greatest development is from the Dakotas and Montana along the dry plains to Texas, New Mexico, and northern Mexico. This is perhaps the latest genus of the *Echinacea-Rudbeckia* complex. Since *Dracopis* and *Ratibida* have many characters in common, it is probable that they have had a common ancestor. Evidence in favor of the more recent origin of this genus is to be found in (1) the distribution in a more recent territory, geologically speaking, (2) the pinnate leaves, (3) the specialized seed dispersal, and (4) the aggressive and weedy nature of many of the species.

GENERAL DISTRIBUTION

The geographical distribution of the several genera comprised in this study, except in the case of *Zaluzania,* is coincident for the most part with certain botanical regions in the United States and in Mexico. *Balsamorhiza, Echinacea,* and *Ratibida* are native of the United States. The first-mentioned genus is confined to the northwestern states, whereas the other two genera are confined chiefly to the central and west-central states. The geographical range of *Ratibida* extends southwestward into northern Mexico. *Iostephane*, *Greenmaniella,* and

Zaluzania are mainly of Mexican distribution. Two species of *Zaluzania,* however, are extralimital; *Z. Grayana,* for example, reaches its northern limits in Arizona, while *Z. Sodiroi* is known only from Ecuador, South America. A more detailed distribution of each genus is given in the taxonomic treatment of the respective groups.

Abbreviations

The following abbreviations are used for the various herbaria cited in the taxonomic portion of this study:

F = Herbarium of the Field Museum of Natural History.
G = Gray Herbarium of Harvard University.
K = Herbarium of the Royal Botanic Gardens, Kew.
M = Herbarium of the Missouri Botanical Garden.
NY = Herbarium of the New York Botanical Garden.
Ph = Herbarium of the Academy of Natural Sciences, Philadelphia.
RM = Rocky Mountain Herbarium, University of Wyoming.
U CAL = Herbarium of the University of California.
US = United States National Herbarium.
WU = Herbarium of Willamette University.

Part II. Taxonomy

KEY TO THE GENERA

A. Ray-flowers without styles.
B. Receptacle columnar, cylindric, or conic-cylindric at maturity.
C. Receptacle columnar; bracts of the involucre biseriate, the inner series one-half or less as long as the outer.
D. Mature achenes terete, transversely wrinkled; leaves simple..... *Dracopis*
DD. Mature achenes compressed-rhomboidal or laterally flattened, smooth; leaves pinnate.. *Ratibida*
CC. Receptacle cylindric or conic-cylindric; bracts of the involucre bi- to tri-seriate, of about equal length............................ *Rudbeckia*
BB. Receptacle conical.
E. Achenes with the crowns slightly rounded, epappose or with a few minute caducous squamellae.......................... *Iostephane*
EE. Achenes terminating abruptly into a truncate, toothed crown.
F. Corolla expanded below into a bulb-like base, contracted above into the cylindrical corolla-tube; pales with stout subuliferous apices .... *Echinacea*
FF. Corolla tubular; pales acute.......................... *Rudbeckia*

AA. Ray-flowers styliferous.

G. Pales firm, subherbaceous to subcoriaceous; mature disk-achenes linear-oblong, rhomboidal or quadrangular; epappose.

H. Base of the disk-corolla dilated and capping the achene; receptacle conical; heads small to medium (disk 0.5–1 cm. broad), usually in corymbose or corymbose-paniculate clusters .... *Zaluzania*

HH. Base of disk-corolla narrow; receptacle broadly convex; heads large (disk 2–4 cm. broad), usually solitary...... .... *Balsamorhiza*

GG. Pales membranaceous with several brownish-resinous parallel nerves; mature disk-achenes subfusiform, subterete; pappus a shallow cup-like crown with knob-like projections at the angles.................................... *Greenmaniella*

Ratibida Raf.

History.—The name *Ratibida* was proposed by Rafinesque[1] and a brief description of it was published in his 'Flora Ludoviciana' in 1817. The genus was based on *Rudbeckia columnaris* Pursh[2] of 1814. Pursh's characterization is identical with that of *Rudbeckia columnaris* Sims[3] in 'Curtis' Botanical Magazine' which appeared in 1813. Sims' description is accompanied by an excellent illustration, hence there can be no doubt as to the identity of the plant concerned. Furthermore, Rafinesque in his 'Flora Ludoviciana' states that "all the species with naked seeds as *R. pinnata &* must form my genus *Obelisteca,* and those with a simple perianthe, such as *R. columnaris* Pursh, my genus *Ratibida.* Raf." Moreover, in 1818, he[4] writes briefly of this genus; and in the following year he[5] published a full description of it in the 'Journal de Physique' where *Rudbeckia columnaris* Pursh is given as the name-carrying synonym.

The name *Rudbeckia columnifera* Nutt.[6] was first published in 'Fraser's Catalogue' in 1813. The description accompanying it is so indefinite that the name *R. columnifera* may be re-

[1] Rafinesque, C. S., Florula Ludoviciana. p. 73. 1817.

[2] Pursh, F., Fl. Am. Sept. **2**: 575. 1814.

[3] Sims, J., in Curt. Bot. Mag. **39**: *pl. 1601.* 1813.

[4] Rafinesque, C. S., in Am. Month. Mag. 268. 1818.

[5] Rafinesque, C. S., in Jour. Phys. & Chem. **89**: 100. 1819.

[6] Nuttall, T., in Fraser's Cat. no. 75. 1813 [Reprint in Pittonia **2**: 118. 1890].

garded as a *nomen subnudum.* Nuttall[7] himself in the 'Genera of North American Plants' in 1818 abandoned his name *R. columnifera* and recognized *Rudbeckia columnaris* Pursh.

The first description of *Lepachys* Raf. immediately follows that of *Ratibida* Raf. in the 'Journal de Physique' in 1819. It was based upon *Rudbeckia pinnata* Vent. It has since been regarded as congeneric with *Ratibida* Raf. Therefore, according to the International Rules of Botanical Nomenclature, *Ratibida* becomes the valid generic name with *Ratibida columnaris* as the type species.

In 1825 Cassini,[8] in 'Dictionnaire des Sciences Naturelles,' described the genus *Obeliscaria* which is based on *Rudbeckia pinnata* Vent. DeCandolle[9] in the 'Prodromus' in 1836 recognized Cassini's genus and treated *Ratibida* and *Lepachys* as sections under *Obeliscaria.*

Don,[10] in Sweet's 'British Flower Garden,' in 1838, was the first worker to recognize *Ratibida.* Barnhart,[11] in 1897, was next to recognize the validity of this name, and *Lepachys* was rejected for reasons similar to those given above.

The genus *Lepachys,* with its three species and one variety, was treated by Torrey and Gray[12] in their 'Flora of North America' in 1842. *Rudbeckia Tagetes* James was transferred to *Lepachys Tagetes* by Gray[13] in 'Pacific Railroad Report' in 1856. The last species to be described was *Lepachys mexicana* Watson[14] in 'Proceedings of the American Academy' in 1888.

GENERAL MORPHOLOGY

Roots.—The root system of *Ratibida* is of two types, namely, a vertical tap-root, and a fibrous or fleshy fibrous spreading root system. The first type is represented in its best development by *R. Tagetes,* where the roots are long, slender, vertical,

[7] Nuttall, T., Gen. N. Am. Pl. **2**: 178. 1818.
[8] Cassini, M. H., in Dict. Sci. Nat. **35**: 272. 1825.
[9] DeCandolle, A., Prodr. **5**: 558. 1836.
[10] Don, D., in Sweet's Brit. Fl. Gard. II, **4**: 361, *pl. 361.* 1838.
[11] Barnhart, J. H., in Bull. Torr. Bot. Club **24**: 410. 1897.
[12] Torrey, J. & Gray, A., Fl. N. Am. **2**: 313. 1842.
[13] Gray, A., in Pacif. Rail. Rept. **4**: 103. 1856.
[14] Watson, S., in Proc. Am. Acad. **23**: 277. 1888.

and rather deep-seated. A less-developed form of the first type is found in *R. columnaris* and *R. peduncularis,* which have a narrow, conical tap-root soon tapering to a slender tip. In these species, the roots are shallow, the main body being usually less than 1 dm. in depth. Plants with this type of root are biennials or short-lived perennials. The more extensively developed root system of *R. Tagetes* is of perennial duration.

Ratibida pinnata and *R. mexicana* possess the shallow horizontally developed or rhizome-like root from which many stout fibrous secondary roots develop. These species are perennials.

Stems.—The stems are herbaceous, erect, simple, or branched, often copiously so, giving the plant a compact bushy appearance, as in *R. Tagetes.* The leafy branches terminate in naked peduncles of varying lengths. The strongly sulcate character of the stem and branches, with regular light green ridges and dark green grooves, is a marked feature of nearly all species of this group.

Leaves.—The leaves are alternate, the lowermost long-petiolate and the uppermost short-petiolate to sessile. The blades are pinnate-cleft, pinnate to bipinnatifid. The basal leaves in *R. mexicana* are lanceolate, those of the stem 3–5-pinnate-cleft. The leaves of *R. pinnata* and *R. mexicana* are distinctly triple-nerved. This character is less pronounced in the other species.

Pubescence.—The hirsute to strigose-hirsute type of pubescence is prevalent throughout the genus. The basal leaf-petioles and the lower parts of the stems are spreading-hirsute, exemplified by *R. mexicana, R. peduncularis,* and *R. pinnata.* The upper parts of the leafy stems, as well as the long naked peduncles, are strigose-hirsute, or less frequently strigose-hirtellous. The leaves are sometimes tuberculate-strigose-hirsute, as illustrated by *R. Tagetes* and *R. pinnata.* The pubescence of the leaves and stems is always interspersed with resinous glands or globules. On the stems this is more pronounced in the grooves, while the ridges are strigose-hirsute.

Inflorescence.—The heads are solitary on long naked peduncles terminating the leafy branches.

a. Involucre.—The involucral bracts are herbaceous and biseriate; those of the inner series are oblanceolate, scarcely longer than the pales or often somewhat shorter; those of the outer series are linear, reflexed or spreading, and from two to three times longer than the inner series. The involucre, while characteristic for the genus, presents few characters of value in specific differentiation.

b. Receptacle and Pales.—The narrow columnar type of receptacle is characteristic of all the species of *Ratibida.* This varies in length somewhat within the genus, but reaches its maximum development in *R. columnaris.*

The pales are densely crowded, more or less conduplicate. The apices are broadly apiculate-obtuse, with the tip incurved and densely velutinous, thus giving the heads a velvety aspect. A narrow fusiform resin duct along the edge of each pale is present in all the species except *R. mexicana.* The pales closely clasp the achenes so that upon drying after maturity they separate from the receptacle and fall with the ripened achene.

c. Corollas.—All the species of *Ratibida* have heterogamous heads with neutral ligulate florets and fertile disk-florets. The 5-lobed disk-corollas are inflated-tubular. The corollas of the ray-flowers are usually yellow, but the color varies in some species from yellow to bluish-purple. This is especially demonstrated in *R. columnaris,* in which the rays range from yellow, blotched with bluish-purple at the base or to the middle, to entirely bluish-purple. A similar color variation is also common in *R. peduncularis* and its variety. The rays are broadly oblong-elliptical, rotund-ovate to oblong-lanceolate, 2–3-denticulate, strongly spreading or reflexed, often cleft to the top of the achene.

d. Achenes.—The achenes of the disk-flowers in *Ratibida* are laterally compressed, with margins acute, or prolonged into a flattened edge, with margins distinctly pectinate-fimbriate, as in *R. peduncularis,* or fimbriate-ciliate, as in *R. columnaris* and *R. Tagetes;* the body of the achene is glabrous.

Pappus.—Pappus none, or consisting of two reduced awns, or of a small crown bordered by minute teeth.

Geographical Distribution.—The genus *Ratibida* is confined chiefly to the central United States, its center of distribution lying in the region of Nebraska and Kansas. The majority of the species are inhabitants of dry soils, but the species are generally quite adaptable and respond readily to a more favorable environment.

The species *R. columnaris,* native of the region from the Dakotas and Montana south to Texas and Mexico, has migrated since the development of the railroads into territory east, west, and southwest of its former range. The more favorable environment, especially in Missouri and Illinois, produces more vigorous plants than those growing in Texas, Oklahoma, etc.

Ratibida pinnata is confined chiefly to the prairie states. The remaining species are of a southwestern distribution; *R. Tagetes,* an inhabitant of dry plains, prairies, and rocky hillsides, ranges from Kansas and Colorado south to Texas and northern Mexico. *Ratibida peduncularis* and its variety *picta* inhabit the Gulf coastal region of Louisiana and Texas. *Ratibida mexicana,* the only Mexican species, inhabits cool slopes of the Sierra Madre Mountains of Chihuahua and Durango.

TAXONOMY

Ratibida Raf. Fl. Ludovic. p. 73. 1817; in Jour. Phys. **89**: 100. 1819; D. Don in Sweet's Brit. Fl. Gard. **4**: 361, *pl. 361.* 1838; Barnh. in Bull. Torr. Bot. Club **24**: 410. 1897; Britt. & Brown, Ill. Fl. ed. 1, **3**: 419. 1898, and ed. 2, **3**: 474. 1913; Small, Fl. Southeast. U. S. ed. 1, 1260. 1903, and ed. 2, 1260. 1913; Coult. & Nels. Bot. Rocky Mts. 545. 1909; Woot. & Standl. in Contr. U. S. Nat. Herb. [Fl. N. Mex.] **19**: 705. 1915; Rydb. Fl. Rocky Mts. 927. 1917; Small, Man. Southeast. Fl. 1428. 1933.

Lepachys Raf. in Jour. Phys. **89**: 100. 1819; Cass. in Dict. Sci. Nat. **26**: 3. 1823; Less. Syn. Gen. Comp. 225. 1832; Torr. & Gray, Fl. N. Am. **2**: 313. 1842; Gray, Manual, 225. 1848; Benth. & Hook. Gen. Pl. **2**: 366. 1873; Gray, Syn. Fl. N. Am. **1**²: 263. 1884; Hoffm. in Engl. & Prantl, Nat. Pflanzenfam. IV. Abt. 5, 233. 1890; Coult. in Contr. U. S. Nat. Herb. [Bot. West.

Texas] **2**: 215. 1892; Rob. & Fern. in Gray's Manual, ed. 7, 832. 1908; Rydb. Fl. Pr. & Pl. Cent. N. Am. 838. 1932.

Obeliscaria Cass. in Dict. Sci. Nat. **35**: 272. 1825; DC. Prodr. **5**: 558. 1836.

Herbaceous biennials or perennials arising from horizontal or vertical rootstalks. Stem simple or branched, erect or occasionally horizontally spreading, sulcate, marked by alternating light and dark green lines. Leaves alternate, pinnate, bipinnate, or lyrately pinnatifid, the basal sometimes lanceolate, serrate or entire, acute, strigose-hirsute, tuberculate-strigose-hirsute and interspersed with glandular punctae, especially on the lower surface. Heads radiate, solitary on naked peduncles, cylindrical, oblong-cylindrical to globose. Bracts of the involucre biseriate, herbaceous, linear to linear-lanceolate, the outer series twice or more the length of the inner. Receptacle columnar. Pales more or less conduplicate, obtusely apiculate to truncately apiculate, the tip incurved, a linear or elliptical brownish resin duct usually present along each margin, apex densely puberulent or velutinous, deciduous with the mature achenes. Disk-flowers with a very short tube, throat inflated-tubular, 5-lobed, glabrous; anthers sagittate at the base with ovate appendages; style-branches recurved or spreading, apex acute or rounded, densely puberulent to hirsutulous. Ray-flowers neutral, rays yellow or bluish-purple, 2–3-dentate, the corolla-tube short or obsolete. Achenes laterally flattened, compressed-rhomboidal in cross-section, sometimes ciliate or pectinate-fimbriate along the edges, otherwise glabrous; pappus when present coroniform or prolonged upwards on each edge, forming two awn-like teeth.

Type species: *R. columnaris* (Sims) D. Don in Sweet's Brit. Fl. Gard. **4**: 361, *pl. 361.* 1838.

KEY TO THE SPECIES

A. Achenes strongly compressed or flattened, inner wing fimbriate; pappus consisting of two tooth-like projections or a lacerate crown.

B. Heads globular or oblong; achenial crown yellowish, thickened, bordered by minute lacerate setae.................................... *2. R. Tagetes*

BB. Heads cylindrical or columnar; pappus consisting of two persistent tooth-like projections.

C. Plants erect, leafy throughout .... *1. R. columnaris*

CC. Plants erect, horizontally spreading, or ascending, leafy below, terminating in a long naked peduncle.

D. Leaves bipinnatifid; achenes pectinate-fimbriate along both edges .... *3. R. peduncularis*

DD. Leaves lyrately pinnate; achenes fimbriate-pectinate along the inner edge .... *3a. R. peduncularis* var. *picta*

AA. Achenes compressed-rhomboidal, not winged; pappus absent.

E. Basal leaves pinnate; pales with a linear brownish resin duct along each margin; plants branched above .... *4. R. pinnata*

EE. Basal leaves lanceolate, entire; pales without resin ducts; plants unbranched .... *5. R. mexicana*

1. **Ratibida columnaris** (Sims) D. Don in Sweet's Brit. Fl. Gard. **4**: 361, *pl. 361.* 1838; Britt. & Brown, Ill. Fl. ed. 1, **3**: 419. 1898, and ed. 2, **3**: 474, *fig. 4454.* 1913; Small, Fl. Southeast. U. S. ed. 1, 1260. 1903, and ed. 2, 1260. 1913; Coult. & Nels. Bot. Rocky Mts. 545. 1909; Small, Man. Southeast. Fl. 1428. 1933.

Rudbeckia columnaris Sims in Curt. Bot. Mag. **39**: *pl. 1601.* 1813; Pursh, Fl. Am. Sept. **2**: 575. 1814; Nutt. Gen. N. Am. Pl. **2**: 178. 1818; Maund, Bot. Gard. **4**: *pl. 84;* n. 336. 1831; Hook. Fl. Bor.-Am. **1**: 311. [1834] 1840; Hemsl. Biol. Cent.-Am. Bot. **2**: 167. 1881.

Rudbeckia columnifera Nutt. in Fraser's Cat. n. 75. 1813.

Ratibida sulcata Raf. in Jour. Phys. **89**: 100. 1819.

Obeliscaria columnaris DC. Prodr. **5**: 559. 1836.

Lepachys columnaris (Sims) Torr. & Gray, Fl. N. Am. **2**: 315. 1842; Gray, Syn. Fl. N. Am. **1**^{2}: 264. 1884; Coult. in Contr. U. S. Nat. Herb. [Bot. West. Texas] **2**: 215. 1892; Rob. & Fern. in Gray's Manual, ed. 7, 833. 1908.

Ratibida columnifera (Nutt.) Woot. & Standl. in Contr. U. S. Nat. Herb. [Fl. N. Mex.] **19**: 706. 1915; Rydb. Fl. Rocky Mts. 927. 1917.

Lepachys columnifera (Nutt.) Macbr. in Contr. Gray Herb. No. 65: 45. 1922; Rydb. Fl. Pr. & Pl. Cent. N. Am. 838. 1932.

Stems one or more, erect, 2.5–12 dm. tall, branched, closely strigose-hirsute throughout with occasional interspersed resinous glands, sometimes hirtellous-strigose, lateral branches spreading; leaves including the petiole 3–15 cm. long, closely strigose-hirsute on both surfaces, interspersed by numerous punctate glands, pinnately cleft to the midrib into 5–13 linear,

narrowly lanceolate, oblong or oblong-lanceolate divisions, these entire or sometimes trifid, acute, 0.5–3 cm. long, 1–10 mm. broad; heads cylindrical, 1–5.5 cm. long, 7–10 mm. broad; outer bracts of the involucre linear, 4–12 mm. long, acuminate, the inner about 3 mm. long, strigose-hirsute; ray-flowers 3–7, rays yellow throughout, broadly oblong-elliptical, 1–2 cm. long, 0.6–1 cm. broad, trifid, tube and outer surface of ray puberulent; mature achenes compressed, 2 mm. long, glabrous, except the wing on the inner side, which is ciliate-fimbriate, pappus consisting of two tooth-like projections on each edge of the crown.

Distribution: Illinois to Minnesota and Montana, south to Texas and Mexico.

The following, selected from numerous specimens, are representative:

Illinois: railroad, Edwardsville, Madison Co., June 26, 1891, *Eggert* (M).

Missouri: dry sandy ground, Hannibal, Marion Co., Aug. 7, 1912, *Davis 5114* (M); railroad tracks, Winfield, Lincoln Co., June 7, 1916, *Davis 1390* (M); common, introduced, Sheffield, Jackson Co., June 26, 1894, *Bush 157* (M); waste ground, Courtney, Jackson Co., July 7, 1894, *Bush 163* (M).

Arkansas: rocky open ground, Brentwood, Washington Co., July 7, 1915, *Palmer 8216* (M).

Minnesota: Brown Valley, Traverse Co., Sept., 1893, *Sheldon* (M); Glyndon, Clay Co., Sept., 1892, *Dewart* (M).

North Dakota: Ryder, Ward Co., July 31, 1928, *Larsen 187* (M).

South Dakota: Brookings, Brookings Co., Aug. 7, 1893, *Thornber* (M); Iriquois, Kingsbury Co., Aug. 11, 1897, *Thornber* (M); plains and ravines, "Bad Lands," Cedar Pass, near Interior, Stanley Co., June 29, 1929, *Palmer 37528* (M); hillsides, Deadwood, Lawrence Co., July 13, 1913, *Carr 93* (M).

Nebraska: railroad tracks, Havelock, Lancaster Co., July 13, 1915, *Davis 7320* (M); field, 20 mi. west of Hastings, Adams Co., June 17, 1929, *Mathias 309* (M); Kearney, Buffalo Co., June 27, 1899, *Pammel* (M); Orella, Sioux Co., July 6, 1912, *Pool & Folsom* (M).

Kansas: prairies near Spearville, Ford Co., Aug. 24, 1902, *Eggert* (M); Grinnell, Gove Co., July 15, 1872, *Redfield 485 (3503)* (M); common, near Ulysses, Grant Co., June 24, 1893, *Thompson* (M); Summit, 17 mi. east of Arriba, Marshall Co., June 30, 1926, *Heller 13975* (M); Paola, Miami Co., Aug. 20, 1884, *Oyster 4149* (M); east of Coffeyville, Montgomery Co., June 28, 1929, *Rydberg & Imler 366* (M); prairie, Rice Co., Aug. 23, 1895, *Hitchcock 267* (M); Manhattan, Riley Co., June, 1891, *Ellis* (M).

Oklahoma: sandy soil, 17 mi. n. Boise City, Cimarron Co., Aug. 22, 1927, *Stratton 444* (M); Norman, Nov. 10, 1914, *Emig 366* (M); Lawton, Comanche Co., Aug., 1903, *Duncan* (M); abundant in prairies, Sapulpa, Creek Co., July 22, 1894, *Bush 307* (M); 6½ mi. west of Buffalo, Harper Co., Aug. 20, 1927, *Stratton 399*

(M); Arbuckle Mts., near Davis, Murray Co., June 21, 1917, *Emig 772* (M); Muscogee, Muscogee Co., July, 1880, *Letterman* (M); prairies near Cora, Woods Co., May 28, 1913, *Stevens 764* (M).

Texas: Claude, Armstrong Co., June 25, 1902, *Reverchon 493* (M); common on prairies, San Antonio, Oct. 2, 1900, *Bush 1234* (M); Ridge Springs, 9 mi. south of Marathon, Brewster Co., July, 1921, *Ferris & Duncan 2838* (M); foothills below McKittrick Canyon, alt. 1650 m., Guadalupe Mts., Culberson Co., July 23, 1931, *Moore & Steyermark 3618* (M); prairies, Houston, Harris Co., May 24, 1915, *Palmer 7746* (M); prairies near Canadian, Hemphill Co., Aug. 10, 1900, *Eggert* (M); rocky open ground in canyon, Davis Mts., Jeff Davis Co., June 17, 1926, *Palmer 31021* (M); on prairies, Terrell, Kaufman Co., Oct. 22, 1902, *Reverchon 3337* (M); near Kerrville, Kerr Co., alt. 1600–2000 ft., June 12–19, 1894, *Heller 1850* (M); Lubbock, Lubbock Co., May 19, 1931, *Demaree 7706* (M); along railway near Amarillo, Potter Co., July 13, 1917, *Palmer 12535* (M); dry open plains, Canyon, Randall Co., June 3, 1918, *Palmer 13878* (M); sandy woods, Troupe, Smith Co., May 9, 1902, *Reverchon 3338* (M); Abilene, Taylor Co., May 22, 1902, *Tracy 7891* (M); Del Rio, Valverde Co., April 17, 1930, *Jones 25903* (M).

Montana: dry ground, Bozeman, Gallatin Co., July 26, 1905, *Blankinship 283* (M); Missoula, alt. 3000 ft., Aug. 2, 1909, *M. E. Jones* (M).

Wyoming: Mammoth Hot Springs, Aug. 22, 1892, *Mulford* (M); waste ground, Laramie, Albany Co., alt. 7300 ft., July 27, 1929, *Goodman 226* (M).

Colorado: near Boulder, alt. 5700 ft., July 8, 1920, *Hanson C139* (M); prairie near Denver, Denver Co., alt. 5300 ft., July 14, 1917, *Clokey 2819* (M); Manitou, El Paso Co., Aug., 1884, *Letterman* (M); near Cañon City, Fremont Co., July 8, 1873, *Brandegee 757* (M); Fort Collins, Larimer Co., alt. 5000 ft., July 9, 1896, *Baker* (M); near Pueblo, Pueblo Co., June 29, 1929, *Mathias 526* (M); Ft. Lupton, June 29, 1913, *Johnston 217* (M); Wray, Yuma Co., July, 1919, *Eggleston* (M).

New Mexico: White Mountains, Lincoln Co., alt. 6700 ft., July 31, 1897, *Wooton 261* (M); Nara Visa, Quay Co., Aug. 1, 1911, *Fisher* (M); near Pecos, San Miguel Co., Aug. 20, 1908, *Standley 5124* (M); north of Glorieta, Aug. 24, 1908, *Standley 5279* (M).

Mexico: coahuila—Chojo Grande, 27 miles southeast of Saltillo, Aug. 29, 1904, *Palmer 345* (M); chihuahua—near Colonia Garcia in the Sierra Madres, alt. 7500 ft., Aug. 5, 1899, *Townsend & Barber 230* (M); san luis potosi—Nov., 1910, *Purpus 4768* (M); nuevo leon—near Monterey, alt. 550 m., July, 1911, *Arsène 2603* (M).

1a. forma **pulcherrima** (DC.) W. M. Sharp, comb. nov.

Obeliscaria pulcherrima DC. Prodr. **5**: 559. 1836.

Ratibida columnaris var. *pulcherrima* (DC.) D. Don in Sweet's Brit. Fl. Gard. II. **4**: 361, *pl. 361.* 1838; Coult. & Nels. Bot. Rocky Mts. 545. 1909.

Lepachys columnaris var. *pulcherrima* (DC.) Torr. & Gray, Fl. N. Am. **2**: 315. 1842; Gray, Syn. Fl. N. Am. **1**^{2}: 264. 1884; Rob. & Fern. in Gray's Manual, ed. 7, 833. 1908.

Ratibida columnifera var. *pulcherrima* (DC.) Woot. & Standl. in Contr. U. S. Nat. Herb. [Fl. N. Mex.] **19**: 706. 1915.

Habit, foliage, pubescence, etc. identical with the species; ray-flowers bluish-purple, or bluish-purple blotched at the base.

Distribution: same as the species.

The following, selected from numerous specimens, are representative:

MISSOURI: waste ground, Sheffield, Jackson Co., June 17, 1918, *Bush 8407* (M).

ARKANSAS: open ground, Fulton, Hempstead Co., June 17, 1915, *Palmer 8024* (M); railroad near Mandeville, Miller Co., June 10, 1898, *Eggert* (M).

NORTH DAKOTA: Ryder, Ward Co., July 31, 1928, *Larsen 194* (M).

SOUTH DAKOTA: Iriquois, Kingsbury Co., Aug. 1, 1892, *Thornber* (M).

NEBRASKA: sand hills, Cherry Co., 1892, *Smith & Pound 145* (M); Lincoln, Lancaster Co., July 11, 1899, *Hedgcock* (M); common in prairies, Sioux Co., July–Aug., 1927, *Kramer 60* (M).

KANSAS: Ellis Co., June 26, 1885, *Kellerman* (M); New Ulysses, Grant Co., June 24, 1896, *Thompson* (M).

OKLAHOMA: Frederick, Tillman Co., July 5, 1903, *Duncan 28* (M).

TEXAS: Bryan, Brazos Co., May 27, 1915, *Palmer 7792* (M); vicinity of Brownsville, Cameron, Co., Aug. 1–5, 1921, *Ferris & Duncan 3113* (M); railroad near Longview, Gregg Co., June 7, 1899, *Eggert* (M); near Lubbock, Lubbock Co., May, 1930, *Demaree 7706a* (M); Corpus Christi, Nueces Co., May, 1913, *Orcutt 5821* (M); sandy woods, Troupe, Smith Co., May 9, 1902, *Reverchon 3338* in part (M); Austin, Travis Co., Aug., 1882, *Kellerman* (M); Del Rio, April 20, 1930, *Jones 25904* (M).

WYOMING: Willow Creek, July 20, 1894, *Nelson 570* (M); Manville, Niobrara Co., July 18, 1901, *Nelson* (M).

COLORADO: Fort Collins, Larimer Co., alt. 5000 ft., July 27, 1892, *Crandall* (M); Cheyenne Cañon, Colorado Springs, El Paso Co., Aug. 24, 1915, *Drushel 4191* (M); Denver, Denver Co., Aug. 5, 1885, *Fritchey 167* (M); Pagosa Springs, Archuleta Co., Aug. 13, 1917, *Payson 1164* (M).

NEW MEXICO: valley of the Pecos, Aug. 13, 1847, *Fendler 387* (M); Nara Visa, Ouray Co., Sept. 19, 1910, *Fisher* (M); Mogollon Mts., on the middle fork of the Gila River, Socorro Co., Aug. 8, 1903, *Metcalfe 415* (M); Carson Forest, Rio Arriba Co., 2100 m., Aug. 14, 1924, *Eggleston 20562* (M); White Mts., Lincoln Co., alt. 6500 ft., July 30, 1897, *Wooton 247* (M); near Pecos, alt. 6700 ft., Lincoln Co., Aug. 15, 1908, *Standley 4925* (M).

MEXICO: NEUVO LEON—Carrizitos, May 28, 1847, *Gregg 810* (M); COAHUILA—Matamoros, April 12, 1906, *Tracy 8947a* (M).

2. **Ratibida Tagetes** (James) Barnh. in Bull. Torr. Bot. Club **24**: 410. 1897; Britt. & Brown, Ill. Fl. ed. 1, **3**: 419. 1898, and ed. 2, **3**: 475. 1913; Small, Fl. Southeast. U. S. ed. 1, 1260. 1903, and ed. 2, 1260. 1913; Woot. & Standl. in Contr. U. S. Nat.

Herb. [Fl. N. Mex.] **19**: 706. 1915; Rydb. Fl. Rocky Mts. 927. 1917.

Rudbeckia Tagetes James in Long's Exp. [Phila. ed.] **2**: 68. 1823.

Obeliscaria Tagetes (James) DC. Prodr. **5**: 559. 1836.

Lepachys columnaris var. *Tagetes* (James) Gray in Smithson. Inst. Contr. [Pl. Wright. pt. 1] **3**: 106. 1852.

Lepachys Tagetes (James) Gray in Pacif. R. R. Rept. **4**: 103. 1856; Gray, Syn. Fl. N. Am. **1**^{2}: 264. 1884; Coult. in Contr. U. S. Nat. Herb. [Bot. West. Texas] **2**: 215. 1892; Rydb. Fl. Pr. & Pl. Cent. N. Am. 838. 1932.

Stems slender, erect, the branches numerous, ascending, often giving the plant a bushy appearance, 1.5–4 dm. tall, strigose-hirsute, interspersed by numerous sessile glands especially in the grooves; leaves strigose-hirsute or tuberculate-strigose-hirsute on both surfaces, interspersed by numerous dark, resinous or punctate glands; basal and lower cauline leaves lanceolate, entire, or more often pinnately or bipinnately 3–5-cleft, 5–13 cm. long including the petiole, upper cauline usually 3–5-cleft into linear or linear-lanceolate segments, these 0.5–3 cm. long, 1–3 mm. broad, entire, acute; heads on peduncles 2–7 cm. long, numerous, often forming close clusters, globular to oblong, 0.8–1.5 cm. long, 8–10 mm. broad; ray-flowers 5–7, rays rotund-ovate to oblong-ovate, 4–6 mm. long, 3–5 mm. broad, trifid, reflexed, yellowish to bluish-purple, pubescent on the outer surface of the lamina; achenes ovate-oblong, 2–2.5 mm. long, winged on the inner edge, truncate, terminating in a thickened, usually yellowish crown which is bordered by minute lacerate setae, achenial body glabrous except along the fimbriate-ciliate wing.

Distribution: dry plains, prairies, and rocky hillsides, Kansas and Colorado, southward to Texas and northern Mexico.

Kansas: Tribune, July 28, 1892, *Reed* (M); Johnson, Stanton Co., July 1, 1893, *Thompson* (M); prairie, Russell Co., July 13, 1895, *Hitchcock 268* (M); roadside, 7 mi. west of Meade, July 10, 1929, *Rydberg & Imler 807* (M); Wallace, Aug. 22, 1884, *Letterman* (M).

Oklahoma: on gypsum hill, near Hollis, Harmon Co., June 21, 1913, *Stevens 1080* (M).

TEXAS: dry ground, Amarillo, Potter Co., July 13, 1917, *Palmer 12534* (M); Teeline, Aug. 26–28, 1903, *Griffiths 5641* (M); Tascosa, June 24, 1902, *Reverchon 3340* (M); Sierra Blanca, July 3, 1895, *Mulford 260* (M); Amarillo, May 29, 1902, *Reverchon* (M); dry open ground along Rio Grande, near El Paso, El Paso Co., June 19, 1926, *Palmer 31100* (M); dry open plains, Channing, Hartley Co., June 18, 1918, *Palmer 14142* (M); near Lubbock, 1930, *Demaree 7528a* (M); Rio Grande Valley at Canutillo, El Paso Co., July 7, 1911, *Barlow* (M); near El Paso, 1849, *Wright 327* (M).

COLORADO: Iola, Gunnison Co., July 29, 1901, *Baker 667* (M); plains, July 4, 1901, *Eggert* (M); plains east of Denver, July 25, 1874, *Engelmann* (M).

NEW MEXICO: near Pecos, alt. 6700 ft., Aug. 15, 1908, *Standley 4950* (M); Mesilla Valley, Dona Ana Co., June 19, 1906, *Standley* (M); vicinity of Las Vegas, San Miguel Co., July 23, 1926, *Arsène & Benedict 15445* (M); Gray, Lincoln Co., alt. 6000–6500 ft., July, 1900, *Earle & Earle 150* (M); Santa Fe, alt. 7200 ft., July 8, 1897, *Heller 3829* (M); Santa Fe, July 14, 1880, *Rusby 78* (M); near Gray, Lincoln Co., alt. 6000 ft., July 12, 1898, *Skehan 32* (M); Las Cruces, Dona Ana Co., alt. 3900 ft., June 15, 1897, *Wooton 5* (M); San Miguel Co., 1897, *Brandegee 12051* (M); Sandia Mts., Allen's Ranch, alt. 7200 ft., Aug.–Sept., 1914, *Ellis 208* (M); waste fields, Santa Fe, July–Sept., 1847, *Fendler* (M); vicinity of Santa Fe, Galisteo, alt. 1865 m., Aug. 23, 1926, *Arsène & Benedict 15841* (M); Archer Ranch, Brazito, Dona Ana Co., May, 1926, *Child 573* (M); common in sandy soil, "Charius," July 20, 1846, *Wislizenus 25* (M); Mesilla Valley, Dona Ana Co., July 16, 1907, *Wooton & Standley 3315* (M).

MEXICO: State of Chihuahua, Valley of the Rio Grande, Paso del Norte, Sept. 14, 1886, *Pringle 1061* (M); Juarez, June 27, 1891, *Evans* (M).

2a. var. **cinerea** Standley in Muhlenbergia **5**: 30. 1909.

Habit similar to the species; stem and peduncles cinereous, densely matted tomentulose-hirsute; leaves grayish, densely hirsute-strigose, the segments of the upper leaves about 2 mm. broad.

Distribution: dry hillside near Pecos, San Miguel Co., New Mexico.

NEW MEXICO: near Pecos, alt. 6700 ft., Aug. 21, 1908, *Standley 5156* (M), ISOTYPE.

3. **Ratibida peduncularis** (T. & G.) Barnh. in Bull. Torr. Bot. Club **24**: 411. 1897; Small, Fl. Southeast. U. S. ed. 1, 1260. 1903, and ed. 2, 1260. 1913.

Lepachys peduncularis Torr. & Gray, Fl. N. Am. **2**: 315. 1842; Gray, Syn. Fl. N. Am. **1**^{2}: 264. 1884; Coult. in Contr. U. S. Nat. Herb. [Bot. West. Texas] **2**: 216. 1892.

Stems erect or horizontally spreading, leafy below, terminat-

ing in a slender naked peduncle, 1–5 dm. long, spreading-hirsute below, strigose-hirsute to strigose-hirsutulous on the peduncles; leaves more or less bipinnatifid; the blade and petiole 2.5–15 cm. long, strigose-hirsute on both surfaces, interspersed with resinous glands below, segments 5–9, 0.5–5 cm. long, the bipinnate lobes 1–4 mm. broad, acute, the terminal segment sometimes broadly pinnately cleft; heads solitary, columnar, 1.5–4 cm. long, 8–11 mm. broad; the outer bracts of the involucre linear, 6–10 mm. long, acute, hirsutulous, the inner series about 2 mm. long; rays 0.5–2.5 cm. long, reflexed, yellow to bluish-purple, especially towards the base; achenes flat, 4 mm. long including the awn-like projections, the edges winged and conspicuously pectinate-fimbriate, otherwise glabrous.

Distribution: Gulf coastal region of Louisiana and Texas.

LOUISIANA: Cameron, July 4, 1903, *Tracy 8548* (G, M); Cameron Parish, July, 1903, *Cocks* (G).

TEXAS: near Corpus Christi, near sea-level, Nueces Co., May 28–31, 1894, *Heller 1789* (G, M); north of Corpus Christi, March 30, 1932, *Jones 29506* (M); Beeville, March 30, 1932, *Jones 29507* (M); "Felipe de Austin," 1835, *Drummond 108* (G); Hort. Cantab. anno 1848, *Wright* (G).

3a. var. **picta** (Gray) W. M. Sharp, comb. nov.

Lepachys peduncularis var. *picta* Gray in Smithson. Inst. Contr. [Pl. Wright. pt. 1] **3**: 107. 1852; Syn. Fl. N. Am. $\mathbf{1}^2$: 264. 1884; Coult. in Contr. U. S. Nat. Herb. [Bot. West. Texas] **2**: 216. 1892.

Lepachys serratus Buckl. in Proc. Acad. Sci. Phila. **13**: 457. 1861.

Ratibida picta Small, Fl. Southeast. U. S. ed. 1, 1260. 1903, and ed. 2, 1260. 1913.

Leaves lyrately pinnate to pinnately parted, coarsely serrate to incised-serrate; achenes pronouncedly winged and pectinate-fimbriate along the inner edge, outer edge entire or coarsely ciliate; other characters as in the species.

Distribution: sandy woodlands of the Texas coastal region.

TEXAS: Tyler, Tyler Co., Sept. 20, *Reverchon 2229* (M); sandy woods, Hempstead, Waller Co., June 10, 1872, *Hall 336* (G, M); gulf coast, 1849, *Wright* (G); Hort. Cantab., 1848, *Wright* (G); oak woodlands, 30 mi. west of San Antonio, Sept. 18–19, 1879, *Palmer 718* (G); Victoria, April 18, 1905, *Tracy 8914* (G, M).

4. **Ratibida pinnata** (Vent.) Barnh. in Bull. Torr. Bot. Club **24**: 410. 1897; Britt. & Brown, Ill. Fl. ed. 1, **3**: 418. 1898, and ed. 2, **3**: 474. 1913; Small, Fl. Southeast. U. S. ed. 1, 1260. 1903, and ed. 2, 1260. 1913; Small, Man. Southeast. Fl. 1428. 1933.

Rudbeckia pinnata Vent. Desc. Pl. Nouv. Jard. Cels. 71, *pl. 71.* 1800; Sims in Curt. Bot. Mag. **49**: *pl. 2310.* 1822.

Lepachys pinnatifida Raf. in Jour. Phys. **89**: 100. 1819.

Obeliscaria pinnata (Vent.) Cass. in Dict. Sci. Nat. **35**: 272. 1825; **46**: 401. 1827; DC. Prodr. **5**: 558. 1836.

Lepachys pinnata (Vent.) Torr. & Gray, Fl. N. Am. **2**: 314. 1842; Gray, Manual, 225. 1848; Gray, Syn. Fl. N. Am. $\mathbf{1}^2$: 263. 1884; Rob. & Fern. in Gray's Manual, ed. 7, 833. 1908; Rydb. Fl. Pr. & Pl. Cent. N. Am. 838. 1932.

Stems one or more from a horizontal rootstalk, stoutish, branched above, 4–12 dm. tall, spreading-hirsute below, strigose-hirsute to strigose-hirtellous above, intermixed with glandular globules; leaves strigose-hirsute to tuberculate-strigose-hirsute on both surfaces, interspersed with resinous glands; the basal long-petioled, pinnate, 1.5–3.7 dm. long, 3–7-pinnate, the upper short-petiolate, pinnate, 0.6–3 dm. long, leaf-segments 3–9, these linear-lanceolate to broadly lanceolate, triple-nerved, 2–9 cm. long, 0.4–2.5 cm. broad, sparsely serrate to entire, acute; heads oblong-cylindrical, 1.2–2.2 cm. long, 1–1.5 cm. broad; ray-flowers 5–10, rays oblong-lanceolate, 2–6 cm. long, 0.6–1.2 cm. broad, 2–3-dentate, puberulent on the outer surface; achenes 2–3 mm. long, glabrous; pappus absent.

Distribution: dry prairies and rocky glades, etc. Ontario to Georgia, west to Minnesota and Oklahoma.

The following, selected from numerous specimens, are representative:

ONTARIO: Windsor, July 27, 1901, *Macoun 34829* (M).

GEORGIA: high sandy bank of Flint River, Sumter Co., July 11, 1901, *Harper 1051* (M).

OHIO: prairie, Adams Co., Sept. 15, 1930, *Stephenson* (M).

KENTUCKY: Bowling Green, Warren Co., July 6, 1900, *Price* (M).

TENNESSEE: Columbia, Maury Co., 1891, *Shimek* (M); railroad near Dechard, Franklin Co., July 6, 1898, *Eggert* (M).

INDIANA: bank of the Wabash River, ¼ mi. east of Bluffton, Wells Co., July 31, 1906, *Deam 1370* (M).

WISCONSIN: near Lake Beulah, Walworth Co., Aug. 2, 1905, *Shannon 133a* (M).

ILLINOIS: near Tracy, Cook Co., Aug. 22, 1908, *Greenman 3624* (M); prairies near Oquawka, Henderson Co., *Patterson* (M); 7 mi. west of Kankakee, Kankakee Co., Aug. 3, 1912, *Sherff 1601* (M); prairie soil, Wabash, 6 mi. west of Decatur, Macon Co., July 12, 1915, *Clokey 2406* (M); dry rocky open ground, Golconda, Pope Co., Oct. 8, 1919, *Palmer 17003* (M); prairies, Winnebago Co., Aug., 1859, *Bebb 3508* (M).

MINNESOTA: Lake Shetek, Murray Co., July, 1922, *Metcalf 1896* (M).

IOWA: prairies, Armstrong, Emmet Co., Aug. 20, 1897, *Cratty* (M); Ames, Story Co., July 18, 1896, *Pammel & Ball 56* (M); common on prairies, near Dayton, Webster Co., Aug. 21, 1926, *Pammel 17* (M); dry prairie soil, Decatur Co., Aug. 17, 1904, *Anderson* (M); high prairie, Black Hawk Co., July 17, 1929, *Burk 556* (M).

MISSOURI: Shannon Co., July 22, 1891, *Bush* (M); near Independence, Jackson Co., July 9, 1894, *Bush 164* (M); dry open ground, Van Buren, Carter Co., July 6, 1914 *Palmer 6204* (M); in dry soil on rocky slope between Festus and Pevely, Jefferson Co., June 20, 1929, *Steyermark 1036* (M); near Allenton, St. Louis Co., July 20, 1893, *Letterman* (M); near Mark Twain Cave, Hannibal, Marion Co., July 25, 1918, *Davis* (M); near Eaglerock, June 27, 1897, *Bush 123* (M).

ARKANSAS: dry open ground, near Fulton, Hempstead Co., June 17, 1915, *Palmer 8037* (M); dry rocky hillside near Cotter, Baxter Co., June 16, 1914, *Palmer 6003* (M); Eureka Springs, Carroll Co., July 17, 1898, *Glatfelter* (M).

KANSAS: prairies, Shawnee Co., July 4, 1895, *Norton & Clothier 266* (M); Johnson Co., 1890, *Pellet* (M).

OKLAHOMA: in open shrubby woods, near Miami, Ottawa Co., Aug. 26, 1913, *Stevens 2283* (M).

5. **Ratibida mexicana** (Wats.) W. M. Sharp, comb. nov.

Lepachys mexicana Watson in Proc. Am. Acad. **23**: 277. 1888.

Stems one or more, unbranched, slender, 4–7 dm. tall, spreading-hirsute above; basal leaves lanceolate, 0.5–2.2 dm. long including the petiole, 1–3.5 cm. broad, serrate or serrate-crenulate, acute, attenuate at the base, hirsute on both surfaces, more densely so beneath, intermixed with globular, resinous glands; cauline leaves 3–5 pinnate-cleft or parted, 6–16 cm. long, the terminal lobe lanceolate, about one-half the length of the entire leaf, the lateral segments 1–3 cm. long, acute, sparsely serrate, surface as in the basal leaves; heads solitary on naked peduncles 1.5–5 dm. long, columnar, 1.8–2.5 cm. long, 1–1.3 cm. broad; pales without the brownish resin ducts; ray-flowers 8–15, rays yellow, oblong-lanceolate, 2–2.5 cm. long, 5–7 mm. broad, spreading, tube short, about 1 mm. long, pubescent on

the limb and outer surface; achenes about 3–4 mm. long, glabrous, pappus absent.

Distribution: cool slopes of the Sierra Madre Mts., Mexico.

MEXICO: CHIHUAHUA—cool slopes of the Sierra Madre, alt. 7000–9500 ft., Sept. 28, 1888, *Pringle 1648* (M); cool slopes of the Sierra Madre, Sept. 19, 1887, *Pringle 1305* (NY); Sierra Madre near Colonia Garcia, alt. 8000 ft., July 5, 1899, *Townsend & Barber 101* (M, NY); DURANGO—Sierra Madre, 30 miles north of Guanacevi, 8000–9000 ft., Aug., 18, 1898, *Nelson 4777* (NY).

IOSTEPHANE Benth.

History.—The genus *Iostephane* was first described by Bentham[1] in 'Genera Plantarum' in 1873. The species *Echinacea heterophylla* D. Don[2] was referred to and therefore must be interpreted as the type of the genus. Excellent illustrations of this species may be seen in the 'British Flower Garden' and also in Knowles & Westcott's 'Floral Cabinet,'[3] under *E. dubia.* Hemsley, in 'Biologia Centrali-Americana,'[4] recognized *Iostephane* and added a new species, namely, *I. trilobata* Hemsl.

Hoffmann[5] in Engler and Prantl's 'Die Natürlichen Pflanzenfamilien,' in 1890, briefly characterized the genus and related it to *Rudbeckia* and other allied genera which possess sterile ray-flowers and achenes without a pappus. At this time two species were recognized.

GENERAL MORPHOLOGY

Roots.—The root system consists of a fleshy spindle-shaped tap-root. The outer covering of the true tap-root is roughened by corrugated ridges of a bark-like structure, giving the root a woody appearance, but the interior tissue is fleshy. Its appearance, size, and structure suggest the tap-root of *Balsamorhiza.*

Stems.—The thickened tap-root gives rise to a slender, woody, stem-like body 1–4 inches long. The herbaceous stems arise from buds at the sides, just below the surface of the ground. Alternate scars along this narrowed underground

[1] Bentham, G., in Benth. & Hook. Gen. Pl. **2**: 368. 1873.

[2] Don, D., in Sweet's Brit. Fl. Gard. II, **1**: *pl. 32.* 1831.

[3] Knowles, G. B. & Westcott, F., Fl. Cab. **3**: 163. 1839.

[4] Hemsley, W. B., Biol. Cent.-Am. Bot. **2**: 168. 1881.

[5] Hoffmann, O., in Engler & Prantl, Nat. Pflanzenfam. **IV**. Abt. 5. 233. 1890.

structure seem to indicate that it is an erect, perennial, underground stem or rootstalk which has developed from the crown of the tap-root. The stems above ground are herbaceous, erect, semiscapose, and usually unbranched. The taller plants, as *I. heterophylla* var. *Dicksonii*, are branched.

Leaves.—The basal leaves are long-petiolate and very numerous; those of the stem are much reduced. Sometimes only a few bracts are present, and occasionally in *I. heterophylla* and *I. trilobata* the stem is destitute of leaves or bracts. The basal leaves in all species are either pandurate, lobed, or less often ovate, the pandurate outline being the most common type. The bases of the leaf blades are decurrent along the sides of the petioles. The venation is conspicuous in that one or sometimes two prominent veins branch off from the midvein in the broadened basal portion of the leaf, and above and below this point the venation is less prominent. The peculiar triple venation and the decurrent blades are characteristic for all species of the genus. The stem-leaves are usually bracteiform. The lowermost are sometimes leaf-like, and of a similar outline to the basal leaves, but they are always much reduced in size.

Pubescence.—The stem bears a strigose pubescence which is less abundant on the lower parts and gradually increases above. The peduncles are often densely pubescent just below the heads, especially so in *I. heterophylla* and *I. trilobata.* The stem in *I. heterophylla* var. *acutiloba* bears stout tuberculate-hispid hairs. The leaves are usually clothed by a tuberculate-hispid pubescence. Some specimens of *Iostephane trilobata* not only bear the above type of covering, but also hirsute trichomes.

Involucre.—The involucral bracts are usually in two, sometimes three, series. In the subgenus Euiostephane the outer bracts are longer than the innermost, often extending beyond the pales and the disk-flowers. In Chrysopetala the bracts are short, never extending beyond the disk-flowers. They are quite helianthoid, thus giving the head a very characteristic appearance. The bracts are foliaceous, lanceolate, or ovate-acuminate, the pubescence being similar to that of the foliage.

Receptacle.—Two types of receptacle occur within the genus, namely, (1) the Echinacea-Euiostephane type, and (2) the helianthoid type. The receptacle in Euiostephane is strongly conical and about 8 mm. high, in this respect being similar to *Echinacea.* The pales are stout, echinulate, and terminate in a sharp straight or incurved beak. The receptacle in Chrysopetala is little more than the expanded apex of the peduncle. The pales are weak, subcoriaceous, and sharply serrated towards the apex.

Ray-flowers.—The rays are neutral, with the achenes triangular in cross-section instead of rhomboidal as in the disk-flowers. The rays in Euiostephane are purple, oblong, and bidentate. Those of Chrysopetala, as the name signifies, are yellow and obovate. They are short, 7–12 mm. long, whereas those in the former subgenus are over 20 mm. long.

Disk-flowers.—The corolla of the disk-flowers is a typical helianthoid form, as contrasted with that of the *Rudbeckia* and *Echinacea* types. The tube is constricted into a narrow cylinder, extending about one-fourth the entire length of the corolla, then it expands abruptly into the upper cylindrical throat and 5-lobed limb, similar to that of *Helianthus.*

Geographical Distribution.—*Iostephane* is confined chiefly to central Mexico. The general range extends from southwestern Chihuahua southwards along the Mexican Plateau, especially at high elevations, to central and eastern Chiapas. The subgenus Chrysopetala occupies the extreme southeastern part of this range, with its northwestern limits in southeastern Puebla. Euiostephane extends from southern Chihuahua south to southern Puebla. *Iostephane heterophylla* is confined to south-central Mexico, ranging from southwestern San Luis Potosi south to Puebla, Morelos, and Michoacan. Its variety *Dicksonii* occurs from Chihuahua south to Puebla; whereas the variety *acutiloba* is known only from central Jalisco.

The species of this genus, so far as available records show, occur in altitudes above 5500 feet, the average elevation being from 6000 to 8000 feet above sea-level. One collection of *I. tri-*

lobata taken in the vicinity of Oaxaca was collected at an altitude of 9500 feet.

Iostephane is chiefly confined to the oak associations. The species occur on dry rocky hills in the open oak woodlands or among the denser stands of oaks. In this respect the habitat resembles that of certain species of *Echinacea.*

TAXONOMY

Iostephane Benth. in Benth. & Hook. Gen. Pl. **2**: 368. 1873; Hemsl. Biol. Cent.-Am. Bot. **2**: 168. 1881; Hoffm. in Engler & Prantl, Nat. Pflanzenfam. IV, Abt. 5. 233. 1890.

Herbaceous, semiscapose or leafy-stemmed perennials. Stems erect, from a thickened vertical rootstalk, simple or branched. Leaves alternate, radical or cauline, panduriform, trilobed-pandurate, ovate or broadly oblanceolate. Heads solitary, radiate, sometimes disposed in an open few-headed panicle. Involucre campanulate to hemispherical, bracts 2–3-seriate, herbaceous, lanceolate to ovate-oblong, acuminate, entire. Receptacle conical to slightly convex, paleaceous; pales coriaceous, entire to serrate towards the apex, broadly conduplicate, acute, apex straight or incurved. Ray-flowers sterile, disposed in a single row; rays purple or yellow. Disk-flowers perfect; corolla-tube constricted, expanded above into a broadened cylindrical throat and 5-lobed limb; stamens 5, anthers sagittate, the apical appendages ovate. Stigmatic branches acute or acuminate, reflexed or curled, pubescent on the outer surface. Achenes of the ray-flowers sterile; those of the disk fertile, rhomboidal to obcompressed, obtuse, glabrous or pubescent; pappus usually absent, or if present of a few minute paleaceous setae.

Type species: *Iostephane heterophylla* (Cav.) Benth. in Benth. & Hook. Gen. Pl. **2**: 368. 1873.

Subgenus I. **Euiostephane** W. M. Sharp, new subgenus.

Involucre hemispherical, 2–3 cm. in diameter, 15 mm. high; receptacle conical, 5–9 mm. high, 3–6 mm. broad at base; pales rigid, echinulate, entire, acute, stout at the apex; rays purple; disk-achenes oblong-obovate, rhomboidal, cinereous or brown-

ish strigose-pubescent; pappus usually absent, when present of minute paleaceous setae.

Subgenus II. **Chrysopetala** W. M. Sharp, new subgenus.

Involucre campanulate, 1–1.5 cm. in diameter, 6–10 mm. high; receptacle convex, 1–1.5 mm. high, 1–1.5 mm. broad; pales weak, cartilaginous, subechinulate, serrate; rays yellow; disk-achenes oblong-obovate, obcompressed, glabrous; pappus absent.

One species: *I. trilobata* Hemsl.

KEY TO THE SPECIES AND VARIETIES

A. Leaves broadly ovate to ovate-lanceolate, the upper little reduced........ ....*1a. I. heterophylla* var. *Dicksonii*

AA. Leaves ovate-pandurate to pandurate, trilobed or divided, the upper much reduced or lacking.

B. Rays purple; involucre hemispheric, 2–3 cm. in diameter; achenes pubescent.

C. Leaves pandurate, crenate, lateral lobes rounded; stems strigose-hirsute..*1. I. heterophylla*

CC. Leaves trilobed-pandurate, entire or dentate, the lateral lobes acute; stems tuberculate-hispid.............*1b. I. heterophylla* var. *acutiloba*

BB. Rays yellow; involucre campanulate, 1–1.5 cm. in diameter; achenes glabrous..*2. I. trilobata*

1. **Iostephane heterophylla** (Cav.) Benth. in Benth. & Hook. Gen. Pl. **2**: 368. 1873; Hemsl. Biol. Cent.-Am. Bot. **2**: 168. 1881.

Coreopsis heterophylla Cav. Icon. Pl. **3**: 34, *pl. 268.* 1795.

Rudbeckia napifolia HBK. Nov. Gen. & Sp. **4**: 244. 1820.

Echinacea heterophylla (Cav.) D. Don in Sweet, Brit. Fl. Gard. II. **1**: *pl. 32.* 1831.

Echinacea dubia Knowles & Westcott, Fl. Cab. **3**: 163. 1839.

Stems erect, scapose to subscapose, 5–9 dm. tall, unbranched or branched in the taller specimens, striate, strigose-hirsute, densely so near the heads; basal leaves panduriform, with a long constriction between the terminal and the lateral lobes, posterior lobes roundish, crenately toothed, more conspicuously so between the anterior and lateral lobes, 1–3.2 dm. long, 2–6 cm. broad, acute, strigose-tuberculate-hirsute especially on the upper surface, petioles 4–14 cm. long; cauline leaves few,

sessile, oblanceolate to lanceolate, 4–8 cm. long, entire, reduced to narrow lanceolate bracts above; heads solitary, radiate, including the rays 4–9 cm. broad; bracts of the involucre 1.5–2 cm. long, 5–6 mm. broad at the middle, oblong-lanceolate, attenuate, hirsute or hirsute-ciliate; pales 9–10 mm. long, coriaceous, acute at the apex, slightly serrate on the upper margins; rays 2.5–5 cm. long, 7–10 mm. broad, 12–15, bi–tri-dentate; disk-corollas sparsely pubescent on the expanded region; achenes oblong-obovate, about 4 mm. long, obcompressed, pappus absent, crown and body clothed by a brown strigose-hirsute pubescence, becoming less dense towards the base.

Distribution: on dry oak-covered hills, south-central Mexico.

MEXICO: SAN LUIS POTOSI—Alvarez, Sept. 5–10, 1902, *Palmer 65* (G, M, US); region of San Luis Potosi, Sept., 1876, *Schaffner 253* (G); MEXICO—"Santa Fe, Valley of Mexico," July 26, 1865–66, *Bourgeau 602* (G, US); "Santa Fe, Valley of Mexico," Aug. 22, 1903, *Rose & Painter 6493* (G, NY, US); among oak hills, near "El Oro," alt. 9000 ft., Oct. 8, 1902, *Pringle 9929* (G, M, US); dry woodland slopes, Sierra de las Cruces, Aug. 28, 1892, *Pringle 5249* (G, US); Sierra de las Cruces, Sept. 10, 1900, *Pringle 9276* (G); near San Angel, Aug., 1855, *Schaffner 58* (G); MICHOACAN—near Morelia, 1910, *Arsène 5518* (US); near Morelia, Sept. 5, 1909, *Arsène 2464* (US); PUEBLA—on "cerro Tepaxuchitl," alt. 6990 ft., vicinity of Puebla, Aug. 7, 1910, *Arsène & Nicolas 5408* (M, US).

1a. var. **Dicksonii** (Lindl.) W. M. Sharp, comb. nov.

Echinacea Dicksonii Lindl. in Edwards' Bot. Reg. N. S. **1**: *pl. 27.* 1838.

Similar to the species, but usually more robust; stem 0.5–1 m. tall; basal and lower stem-leaves broadly ovate to ovate-lanceolate, 2–4.5 dm. long, 4–15 cm. broad, coarsely dentate, acute at the apex; heads including the rays occasionally 10 cm. in diameter.

Distribution: mountains of Mexico, from southern Chihuahua to Oaxaca.

MEXICO: CHIHUAHUA—southwest Chihuahua, Aug., 1885, *Palmer 333* (G, US); 15 mi. south of Guadalupe Calvo, alt. 7500–8000 ft., southwest Chihuahua, Aug. 22, 1898, *Palmer 4824* (G, US); DURANGO—region of Durango, Aug. 16, 1897, *Rose 2336* (G); JALISCO—in Sierra Madre, west of Bolonas, Sept. 15–17, 1897, *Rose 2969* (G, US); SAN LUIS POTOSI—region of San Luis Potosi, 22° N. lat., alt. 6000–8000 ft., 1878, *Parry & Palmer 470* (G); near Huajalote, *Ehrenberg 344* (G); HIDALGO—on Real del Monte, Hidalgo, *Coulter 374* (G); PUEBLA—vicinity of Puebla, Aug. 8, 1907, *Arsène 1056* (G, M, US); Mt. Orizaba, near Esperanza, Aug. 15, 1891, *Seaton 366* (G, US); vicinity of Esperanza, Sept., 1911, *Purpus 5694*

(G); MORELOS—Cuernavaca, Sept. 30, 1899, *Holway 3543* (G); OAXACA—"Serro San Felipe del agua," alt. 5700 ft., July 25, 1897, *Conzatti & Gonzalez 404* (G).

1b. var. **acutiloba** W. M. Sharp, var. nov.[6]

Stems 4–9 dm. long, tuberculate-hispid, strigose; basal leaves trilobed-pandurate, the lateral lobes ½ as long as the terminal lobe, posterior lobes acute, entire, above tuberculate-hispid, beneath hispid; achenes oblong-obovate, 4–5 mm. long, canescent-strigose towards the summit; in all other characters similar to the species.

Distribution: known only from the state of Jalisco, under oaks on rocky hills.

MEXICO: JALISCO—near Guadalajara, Aug., 1893, *Pringle 4480* (G, M TYPE, US); "Rio Blanco," Aug., 1896, *Palmer 372* (G, NY, US).

2. **Iostephane trilobata** Hemsl. Biol. Cent.-Am. Bot. **2**: 169. 1881.

Rudbeckia chrysantha Klatt in Leopoldina **23**: 143. 1887.

Gymnolomia scaposa Brandegee in Univ. Cal. Publ. Bot. **4**: 93. 1910.

An herbaceous, strigose-pubescent perennial, 1.5–7 dm. tall; stems erect, one or more from a thickened rootstalk; basal leaves panduriform to ovate, 0.5–3 dm. long, 1.5–7 cm. broad, lateral lobes rounded, terminal lobe ovate to subovate, entire to sparsely serrate, hirsute-ciliate, strigose-hirsute below, strigose-tuberculate-hirsute to hirsute above; cauline leaves reduced, lowermost lanceolate, 6 cm. or less long, the uppermost reduced to sessile bracts subtending the branches; petioles of the basal leaves more than half the total length of the blade; heads solitary or disposed in an open few-headed panicle, including the rays 2–5 cm. broad, 6–13 mm. high; involucre campanulate; bracts of the involucre 2–3-seriate, lanceolate-acuminate, hirsute-pubescent; rays 6–13, yellow, 7–12 mm. long; achenes oblong-obovate, obcompressed, glabrous, epappose.

[6] **Iostephane heterophylla** var. **acutiloba** W. M. Sharp, var. nov., caulibus 4–9 dm. longis, tuberculato-hispidis, strigosis; foliis basalibus trilobato-panduratis, lobo terminali lobis lateralibus duplo longiore, lobis posterioribus acutis, integris, supra tuberculato-hispidis, subtus hispidis; achaeniis oblongo-obovatis, 4–5 mm. longis, ad apicem griseo-strigosis; cetera speciei similis.—Collected at Jalisco, Mexico, near Guadalajara, Aug., 1893, *Pringle 4480* (G, M TYPE, US).

Distribution: southern Mexico, in oak forests at elevations above 5000 feet.

MEXICO: PUEBLA—in oak forests, Coxcatlan, alt. 8000–9000 ft., Sept., 1909, *Purpus 4120* (G, M); OAXACA—in Sierra de Chavellinas, alt. 8500 ft., Oct. 19, 1894, *Pringle 4978* (G, M, US); 18 mi. southwest of the city of Oaxaca, alt. 5700–9500 ft., Sept. 10–20, 1894, *Nelson 1371a* (US); CHIAPAS—open forests, near Fenia, July, 1925, *Purpus 55* (G, US); near San Cristobal, alt. 7000–8800 feet, Sept. 18, 1895, *Nelson 3223* (G, US); without locality or date, *Ghiesbreght 101* (G); without locality, coll. of 1864–70, *Ghiesbreght 561* (G, M).

ECHINACEA Moench

History.—Previous to the time of Linnaeus, plants now considered to belong to the genus *Echinacea* were discussed by Plukenet[1] in 'Almagestum Botanicum' in 1696 and by Catesby[2] in 'Natural History' under the name *Chrysanthemum americanum.* Morison[3] in 'Plantarum Historia' in 1699 described *Dracunculus Virginianus latifolius.* Illustrations of both Catesby and Morison are identical with what are now considered to be *Echinacea.* Catesby's plate is apparently that which is now interpreted as *E. laevigata,* but his description accompanying the plate is somewhat vague. In 'Species Plantarum' Linnaeus[4] described an echinaceous plant under *Rudbeckia purpurea.* This name is based on *Chrysanthemum americanum* of Plukenet and of Catesby and on *Dracunculus Virginianus latifolius* of Morison. Necker[5] in 'Elementa' in 1790 described the genus *Brauneria.* No species are mentioned, but the generic description is practically the same as that of *Rudbeckia.* Moench[6] in 'Methodus Plantarum' in 1794 described the genus *Echinacea.* The name is derived from the Latin word "echinus," a hedge-hog, because of the prickly pales of the receptacle which give it a somewhat echinate appearance. His generic characters are clear-cut and comprehensive, the genus being based on *Rudbeckia purpurea* L. which, according

[1] Plukenet, L., Alm. Bot. 99. 1696; *ibid. pl. 21, fig. 1.* 1720.

[2] Catesby, M., Nat. Hist. Car. & Fla., ed. 3, **2**: 59, *pl. 59.* 1771.

[3] Morison, R., Pl. Hist. pt. 3. sect. 6. 42, *pl. 9.* 1699.

[4] Linnaeus, C., Sp. Pl. **2**: 907. 1753.

[5] Necker, J. D., Elem. Bot. **1**: 17. 1790.

[6] Moench, C., Meth. Pl. 591. 1794.

to the International Rules of Botanical Nomenclature, becomes the type species of the genus *Echinacea.*

The botanists of the early and middle nineteenth century adopted the name *Echinacea,* while *Brauneria,* although four years older, remained in obscurity. Lessing,[7] Endlicher,[8] Meisner,[9] Lemaire,[10] and Bentham and Hooker[11] used the former name. Alphonse DeCandolle[12] recognized the name *Echinacea* in the 'Prodromus' and described under it four species. Torrey and Gray[13] in the 'Flora of North America' included three species in this genus. Thomas Nuttall[14] in 'Transactions of the American Philosophical Society' described three species, one of which, *E. pallida* Nutt., is valid at the present time, while the others have been reduced to synonymy or excluded from the genus. Gray,[15] in various editions of his 'Manual of Botany' from 1857–1889, recognized the genus *Echinacea,* listing two species. In the seventh edition, however, the name *Brauneria* is adopted, and four species are given. In the first edition of the 'Illustrated Flora of the Northern United States and Canada' Britton and Brown[16] used the name *Brauneria,* but in the second edition this is replaced by *Echinacea.* Small[17] in 'Flora of the Southeastern United States' recognized the genus *Brauneria* and included six species, four of which are retained in this monograph, one reduced to a variety, and the sixth being excluded.

GENERAL MORPHOLOGY

Stems.—The stems arise from rootstalks which die down each season and come up again in the spring, the parts above the ground thus being annual. The stems are of two types.

[7] Lessing, C. F., Syn. Gen. Comp. 225. 1832.
[8] Endlicher, S., Gen. Pl. 409. 1838.
[9] Meisner, C. F., Pl. Vasc. Gen. 202. 1839.
[10] Lemaire, C., Dict. Hist. Nat. 183–184. 1844.
[11] Bentham, G., & Hooker, J. D., Gen. Pl. **2**: 366. 1873.
[12] DeCandolle, A., Prodr. **5**: 554. 1836.
[13] Torrey, J., & Gray, A., Fl. N. Am. **2**: 305–306. 1842.
[14] Nuttall, T., in Trans. Am. Phil. Soc. II. **7**: 354. 1841.
[15] Gray, A., Man. of Bot., editions 1857–1889.
[16] Britton & Brown, Ill. Fl. ed. 1, **3**: 419. 1898, and ed. 2, **3**: 476. 1913.
[17] Small, J. K., Fl. Southeast. U. S. 1261–1262. 1903.

The first type is usually simple, sometimes once-branched, and one to three feet high, a single rootstalk sometimes giving rise to one or several stems. The second type is usually branched above one to many times, and bears a single head on each branch. The stems in *E. purpurea* commonly attain a height of four to five feet.

Leaves.—The leaves of *Echinacea* fall naturally into two groups, namely, the ovate and the lanceolate. The latter is the most common form in the genus. The basal leaves are usually long-petiolate, and the stem-leaves short-petiolate becoming sessile above. The leaves are normally three to five palmately veined. The primary veins run almost parallel in the narrow-leaved species.

Pubescence.—The pubescence within the genus is variable, each species having a characteristic form. For this reason it is one of the most outstanding taxonomic characters for the group and especially important for a satisfactory separation of the narrow-leaved species. In *Echinacea paradoxa* the pubescence is definitely strigose; in *E. pallida* it is hirsute; while in *E. angustifolia* it is tuberculate-hirsute to tuberculate-hispid. This last species is often referred to as having shaggy pubescence, the tuberculate-hispid hairs giving this appearance. *Echinacea laevigata* is the only glabrous species in the genus.

Involucral bracts.—The bracts of the involucre are usually in two to three series. In *E. paradoxa* the bracts show a marked transition into the pales, this transition indicating plainly the relation of pales to involucre. The pubescence on the bracts in all species is the same type as that of the leaves. When *E. purpurea* is grown in cultivation, abnormal heads are formed; the bracts of the involucre become leaf-like, and the receptacle somewhat elongated, thus showing a reversion perhaps to a more primitive form.

Receptacle and Pales.—The receptacle in *Echinacea* is distinctly conical. The pales on the receptacle are broad and persistent, terminating in coriaceous stiff or weak spines. The spiny apices extend from 1 to 4 mm. beyond the corolla, giving the head an echinate appearance.

Ray-flowers.—The ray-flowers are neutral and disposed in a single series. The rays are strap-shaped, one to three toothed, and in a majority of the species are sparsely pubescent on the outer surface. In *E. pallida* they are 4–9 cm. long and strongly reflexed. The predominating color is purple, but in *E. paradoxa* the rays are yellow.

The Disk-corolla.—The corolla is expanded below into a bulb-like base. This enlarged portion is sessile upon the top of the achene, this being one of the most important generic characters. The corolla contracts above into a cylindrical tube terminated by a five-lobed, erect or slightly ascending limb. The median vascular bundles of the corolla-lobes are absent, but there are five fused lateral bundles which divide at the sinuses and run along the margins of the corresponding lobes. The corolla is dark purplish as a rule. The stamens are five in number, united, and encompass the style. Each stamen is terminated by an ovate membranaceous appendage, sagittate at the base.

GEOGRAPHICAL DISTRIBUTION

The genus *Echinacea* has its center of development in the prairies and glades of the central United States, including the region from Illinois to Iowa, south to Tennessee and Oklahoma. The species are usually inhabitants of dry, rocky glades, with a preference for limestone soils. *Echinacea purpurea* has the widest distribution, its range extending from Georgia, north and west to Kentucky and the Ozarkian region of Missouri and Arkansas. The remaining species are less widely distributed; for example, in the region east of the Mississippi River, *E. laevigata* occurs along the Appalachian Upland east of the Alleghenies from Pennsylvania to Georgia. A more restricted range is found in *E. angustifolia* var. *tennesseensis*, which is known only from the dry, rocky hills or pine barrens of Rutherford County, Tennessee. *Echinacea pallida* is an inhabitant of the prairies and glades of the central United States, and extends into Oklahoma and Texas. *Echinacea paradoxa* is an Ozarkian species extending from southwestern Missouri to Texas, while *E. angustifolia* is confined to the dry prairies and barrens ranging from northern Minnesota to Texas.

Economic Uses.—Echinacea is at present of little importance in an economic way. The main value lies in horticultural possibilities. The New Colwall Strain of *Echinacea purpurea* has been recently placed on the market in England. It is of easy culture, quite hardy, and the handsome heads are often six inches in diameter. The most beautiful part of the head is the cone center which is green or bronze when young and later becomes gorgeously tinted with metallic shades of copper, bright brown, or red. Other species of this genus also make attractive border plants.

TAXONOMY

Echinacea Moench, Meth. Pl. 591. 1794; Less. Syn. Gen. Comp. 225. 1832; DC. Prodr. **5**: 554. 1836; Endl. Gen. Pl. 409. 1838; Meisner, Pl. Vasc. Gen. 202. 1839; Endl. Ench. Bot. 238. 1841; Torr. & Gray, Fl. N. Am. **2**: 305. 1842; Lemaire in Dict. Hist. Nat. 183–184. 1844; Benth. & Hook. Gen. Pl. **2**: 366. 1873; Gray, Syn. Fl. N. Am. **1**^{2}: 258. 1884.

Dracunculus Morison, Pl. Hist. pt. 3. sect. 6. 42, *pl. 9*. 1699.

Bobartia Petiver, Herbal, 473. [1715]. 1704.

Brauneria Necker, Elem. Bot. **1**: 17. 1790.

Helichroa Raf. Neogenyton, 3. 1825.

Herbaceous perennials, arising from vertical or horizontal rootstalks. Stems erect, simple or branched, smooth to variously pubescent. Leaves alternate, ovate, ovate-lanceolate to lanceolate, acute or attenuated, coarsely toothed or entire, dark or light green, smooth or pubescent, 3–5-veined, medium in texture. Involucral bracts 2–3-seriate, foliaceous, linear-lanceolate to lanceolate, attenuate or acute, ciliate, smooth or pubescent, of medium texture. Receptacle distinctly conical. Pales conduplicate, terminating in sharp cartilaginous spines, exceeding the disk-flowers, straight or somewhat incurved. Ray-flowers neutral, disposed in one series, rays strap-shaped, bifid or trifid, purple or occasionally yellow. Disk-flowers fertile. Disk-corollas expanded below into a bulb-like base and sessile upon the achene, contracted above into a cylindrical tube and the five-lobed erect limb, smooth, purplish. Stamens five, anthers sagittate at the base, terminating in an ovate,

membranaceous appendage. Styles usually enlarged slightly at the base, equalling or slightly shorter than the corolla, the branches acuminate, hairy. Achenes four-angled, in cross-section diamond-shaped at top, smooth, often sparsely pubescent on the angles, terminated by a toothed crown, body of the achene usually glabrous, slightly areolated.

Type species: *E. purpurea* Moench, Meth. Pl. 591. 1794.

KEY TO THE SPECIES

A. Leaves ovate to ovate-lanceolate; pales slender, terminating in long weak spines.
B. Stem and leaves hirsute, not glaucous........................*1. E. purpurea*
BB. Stem and leaves smooth or glaucous........................*2. E. laevigata*
AA. Leaves lanceolate, attenuate at each end; pales stout, terminating in stiff spines.
C. Plants hirsute or tuberculate-hirsute; stem and leaves dark green; rays purple.
D. Stem and leaves tuberculate-hirsute to tuberculate-hispid; rays 2–3.5 cm. long, not reflexed............................*3. E. angustifolia*
DD. Stem and leaves hirsute; rays 4–9 cm. long, reflexed........*4. E. pallida*
CC. Plants strigose; stem and leaves light green; rays yellow....*5. E. paradoxa*

1. **Echinacea purpurea** Moench, Meth. Pl. 591. 1794; DC. Prodr. **5**: 554. 1836; Spach, Hist. Nat. Veg. **10**: 52. 1841; Torr. & Gray, Fl. N. Am. **2**: 305. 1842; Gray, Syn. Fl. N. Am. 1^2: 258. 1884; Chapm., Fl. Southern U. S., ed. 3, 248. 1897; Britt. & Brown, Ill. Fl. ed. 2, **3**: 475, *fig. 4456.* 1913; Rydb. Fl. Cent. N. Am. 837. 1932; Small, Man. Southeast. Fl. 1421. 1933.

Rudbeckia purpurea L. Sp. Pl. **2**: 907. 1753; Walt. Fl. Car. 214. 1788; Michx. Fl. Bor.-Am. **2**: 143. 1803; Nutt. Gen. N. Am. Pl. 178. 1818; Link, Enum. Pl. 353. 1821; Barton, Fl. N. Am. **2**: 84, *pl. 64.* 1822; Elliot, Sketch Bot. Car. & Ga. **2**: 449. 1824.

Chrysanthemum americanum Pluk. Alm. Bot. 99. 1696; *ibid. pl. 21. fig. 1.* 1720.

Dracunculus Virginianus latifolius Morison, Pl. Hist. pt. 3. sect. 6. 42, *pl. 9.* 1699.

Rudbeckia serotina Sweet, Brit. Fl. Gard. **1**: *pl. 4.* 1823–25.

Echinacea intermedia Lindl. in Paxt. Mag. Bot. **15**: 79. 1849.

Brauneria purpurea (L.) Britt. Mem. Torr. Bot. Club **5**: 334. 1893; Britt. & Brown, Ill. Fl. ed. 1, **3**: 420, *fig. 3895.* 1898;

Small, Fl. Southeast. U. S. ed. 1, 1261. 1903, and ed. 2, 1261. 1913; Rob. & Fern. in Gray's Manual, ed. 7, 832. 1908.

Stems erect, stout, branched, hirsute below, becoming smooth above, 6–18 dm. high; leaves ovate to ovate-lanceolate, acute, coarsely or sharply serrate below, usually entire above, hirsute on both surfaces, mature leaves often rough to the touch, 3–5-veined; basal leaves long-petiolate, 1.7–4.7 dm. long, 6–9 cm. broad; cauline leaves short-petiolate, sessile above, 7–19 cm. long, 1.5–7 cm. broad; involucral bracts linear-lanceolate, attenuate, entire, ciliate, pubescent on outer surface, texture similar to the leaf; heads 1.5–2.7 cm. high, 1.1–4 cm. broad exclusive of the rays; pales slender, lanceolate, 11–13 mm. long, 1–1.5 mm. broad, terminating in long spines, surpassing the corolla 5–6 mm., smooth, purplish to brownish; rays 4–5.5 cm. long, 5–10 mm. broad, bidentate or entire, reddish-purple; achenes 4–4.5 mm. long, 2–3 mm. broad at top, glabrous.

Distribution: prairies and dry open woods from Ohio to Georgia, west to Iowa and Arkansas.

GEORGIA: dry soil, Gwinnett Co., July 7, 1897, *Eggert* (M); "Griers Fave," Randolph Co., July 17, 1903, *Harper 1884* (M).

OHIO: Mineral Springs, Adams Co., Oct. 5, 1930, *Stephenson* (M).

TENNESSEE: Cumberland Mt., Franklin Co., July 21, 1897, *Eggert* (M); Cumberland Mts., Cowan, July, 1898, *Ruth 646* (M); Wolf Creek, July 28, 1894, *Kearney* (M).

ALABAMA: Chambers Co., June 21, 1897, *Earle* (M).

ILLINOIS: Wady Petra, Stark Co., July 19, 1900, *Chase 685* (M); Hancock Co., *Meade 1841* (M).

MISSOURI: Webster, St. Louis Co., July 27, 1898, *Brownell* (M); Shell Mound, Barry Co., July 11, 1927, *Palmer 32445* (M); near St. Louis, St. Louis Co., Aug. 4, 1892, *Glatfelter 275* (M); Windsor Springs, July 28, 1891, *Douglas* (M); Eureka Springs, July 16, 1898, *Glatfelter* (M); Oakville, Jefferson Co., Sept. 1, 1926, *Mathias* (M); Dasco, Ralls Co., Aug. 13, 1915, *Davis 4864* (M); Hannibal, Marion Co., July 6, 1916, *Davis 1574* (M); Webster Groves, St. Louis Co., Sept., 1920, *Greenman 4007* (M); near Allenton, July 30, 1897, *Letterman* (M); James River, Stone Co., June 3, 1914, *Palmer 5843* (M); Mark Twain's Cave, Marion Co., Aug. 24, 1915, *Davis 3284* (M); Arcadia, Iron Co., Sept., 1897, *Russell* (M); Pleasant Grove, Ripley Co., July 20, 1897, *Mackenzie 373* (M); McDonald Co., July 24, 1892, *Bush* (M); Silex, Lincoln Co., Sept. 16, 1916, *Davis 1844* (M); Jackson Co., Aug. 28, 1884, *Bush* (M); Eagle Rock, Barry Co., June 8, 1897, *Bush 26* (M); Noel, McDonald Co., Sept. 10, 1913, *Palmer 42569* (M); Spring Park, July 24, 1891, *Hassford* (M); Oak Grove, Jackson Co., July 30, 1902, *Mackenzie 64* (M); Monteer, Aug. 8, 1910, *Bush 6146* (M); river bluffs, near Hannibal, Marion Co., Jan. 9, 1915, *Davis 5819* (M).

ARKANSAS: Eureka Springs, July 16, 1898, *Glatfelter* (M); Benton Co., *Plank* (M); Fulton, Hempstead Co., June 19, 1915, *Palmer 8040* (M).

2. **Echinacea laevigata** (Boynton & Beadle) Blake in Jour. Wash. Acad. Sci. **19**: 273. 1929; Small, Man. Southeast. Fl. 1421. 1933.

Brauneria laevigata Boynton & Beadle in Small, Fl. Southeast. U. S. ed. 1, 1261. 1903, and ed. 2, 1261. 1913.

Stems erect, simple or branched, glabrous, striate, 9–12 dm. high; leaves glabrous on both surfaces, palmately 3–5-veined, medium in texture; basal leaves long-petiolate, 18–36 cm. long, 3–7 cm. broad, cauline short-petiolate below, sessile above, ovate to broadly lanceolate, acute, finely serrate, 7–18 cm. long, 2–5 cm. broad; heads 2–2.5 cm. high, 3–3.5 cm. broad exclusive of the rays, pales slender, linear-lanceolate, 9 mm. long, 1 mm. broad, tips curving inwards, surpassing the corolla; rays 3.5–8 cm. long, 3–5 mm. broad, reflexed bidentate, purple; disk-corolla 5 mm. long, purplish; achenes 4 mm. long, glabrous, somewhat areolated, pappus a toothed crown of equal length.

Distribution: fields and woods, Lancaster Co., Pennsylvania, south to South Carolina and Georgia.

PENNSYLVANIA: Lancaster Co., "Caernsvron" township, July, *without collector* (M).

VIRGINIA: Bradford Co., July 18, 1871, *Curtiss 3502* (M); near Staunton, Augusta Co., June 18, 1896, *Murrill* (NY).

SOUTH CAROLINA: Keowee, Oconee Co., May 22, 1906, *House 2206* (M).

GEORGIA: in mountains of Georgia, *Buckley* (M).

3. **Echinacea angustifolia** DC. Prodr. **5**: 554. 1836; Torr. & Gray, Fl. N. Am. **2**: 306. 1842; Gray, Syn. Fl. N. Am. **1**^{2}: 258. 1884; Britt. & Brown, Ill. Fl. ed. 2, **3**: 476, *fig. 4457*. 1913; Rydb. Fl. Pr. & Pl. Cent. N. Am. 837, *fig. 570*. 1932.

Brauneria angustifolia (DC.) Heller in Muhlenbergia **1**: 5. 1900; Small, Fl. Southeast. U. S. ed. 1, 1261. 1903, and ed. 2, 1261. 1913; Rob. & Fernald in Gray's Manual, ed. 7, 832. 1908; Rydb. Fl. Rocky Mts. ed. 1, 926. 1917, and ed. 2, 926. 1922.

Echinacea sanguinea Nutt. in Trans. Am. Phil. Soc. II. **7**: 354. 1841.

Stems simple, 3–5 dm. high, tuberculate-hirsute to tuberculate-hispid; leaves oblong-lanceolate to long-elliptical, entire,

dark green, tuberculate-hirsute to tuberculate-hispid, rough to the touch; basal leaves long-petiolate, 9–22 cm. long, 1–2.5 cm. broad, cauline sessile, 4–14 cm. long, .6–1.5 cm. broad, acute; heads 1.9–3 cm. high, 1.5–2.5 cm. broad exclusive of the rays, involucral bracts lanceolate, acute, entire, 6–11 mm. long, 2–3 mm. wide, densely tuberculate-hirsute or tuberculate-hispid; rays spreading, sparsely pubescent on the veins below, 2–3.5 cm. long, 3–8 mm. broad, once- or twice-notched, purplish; disk-corollas 6–7 mm. long, purplish; achenes 5 mm. long, main body areolated by light brown and dark brown splotches, pappus forming a toothed crown.

Distribution: dry prairies and barrens, Minnesota, south to Texas, west to Wyoming.

MINNESOTA: Pike Lake, Sept. 10, 1849, *Sykes* (M).

NORTH DAKOTA: Minot, Ward Co., Aug. 3, 1928, *Larsen 198* (M).

SOUTH DAKOTA: Brookings, Brookings Co., without date, *Williams* (M); Deadwood, Lawrence Co., July 14, 1913, *Carr 90* (M); Ionia, Lyman Co., July 5, 1910, *Rose* (M); Iriquois, Kingsbury Co., Aug. 9, 1894, *Thornber* (M); Forestburg, Sanborn Co., July 3, 1910, *Visher 4454* (M); near Hot Springs, Fall River Co., June 27, 1929, *Palmer 37546* (M).

NEBRASKA: without locality, July, 1904, *Goodding 2215* (M); Lincoln, Lancaster Co., June, 1886, *Webber* (M).

KANSAS: Ellis Co., 1908–11, *Zeller* (M); Manhattan, Riley Co., July 12, 1892, *Clothier* (M); prairie, June 18, 1895, *Norton 265* (M); Rockport, Rooks Co., June 26, 1889, *Bartholomew* (M); east of Russell, Russell Co., July 1, 1926, *Heller 13984* (M); Fort Kearney, July 10, 1856, *Engelmann* (M).

OKLAHOMA: Cache, Comanche Co., June 25, 1913, *Stevens 1341K* (M); near Fort Sill, June 14, 1916, *Clemens 11837* (M); near Cora, Woods Co., May 28, 1913, *Stevens 737* (M); near Rocky, Washita Co., June 16, 1913, *Stevens 971* (M).

TEXAS: near Canyon City, Randall Co., Aug. 14, 1900, *Eggert* (M); Dallas, Dallas Co., June 15, 1898, *Glatfelter* (M); Comanche Spring, Comanche Co., May, 1849, *Lindheimer 898* (M); Kerrville, Kerr Co., May 7–14, 1894, *Heller 1735* (M); Leon Springs, Bexar Co., *Clemens & Clemens 381* (M).

WYOMING: Lake De Smet, July 30, 1901, *Nelson 8546* (M); Sundance, Crook Co., July 21, 1896, *Nelson 2122* (M); Dome Lake, Sheridan Co., June 27, 1897, *Pammel & Stanton 247* (M).

3a. var. **tennesseensis** (Beadle) Blake in Jour. Wash. Acad. Sci. **19**: 273. 1929.

Brauneria tennesseensis Beadle in Bot. Gaz. **25**: 359. 1898; Small, Fl. Southeast. U. S. ed. 1, 1262. 1903, and ed. 2, 1262. 1913.

Echinacea tennesseensis (Beadle) Small, Man. Southeast. Fl. 1421. 1933.

Stems usually simple, 1–4.5 dm. high, hirsute or tuberculate-hirsute; leaves narrowly oblong or long-elliptical, acute, entire, 2–13 cm. long, 3–7 mm. broad, hirsute, often tuberculate-hirsute, short-petiolate below, sessile above; involucral bracts linear, 5–7 mm. long, 2 mm. broad, hirsute-ciliate; achenes 4.5–5 mm. long, glabrous.

Distribution: pine barrens and dry hills, Tennessee.

TENNESSEE: Lavergne, Rutherford Co., July 14–Aug. 18, 1897, *Eggert* (M); Lavergne, Sept. 7, 1898, *Eggert* (M); same locality, Aug. 19, 1897, *Biltmore Herb. 1107* (M); cedar barrens, "middle" Tennessee, July 18–19, *Gattinger* (M).

4. **Echinacea pallida** Nutt. in Trans. Am. Phil. Soc. II. **7**: 354. 1841; Britt. & Brown, Ill. Fl. ed. 2, **3**: 476, *fig. 4458.* 1913; Rydb. Fl. Pr. & Pl. Cent. N. Am. 837. 1932; Small, Man. Southeast. Fl. 1421. 1933.

Echinacea angustifolia Hook. in Curt. Bot. Mag. **17**: *pl. 5281.* 1861, not DC.

Rudbeckia pallida Nutt. in Jour. Acad. Nat. Sci. Phila. **7**: 17. 1834.

Brauneria pallida Britt. in Mem. Torr. Bot. Club **5**: 333. 1894; Britt. & Brown, Ill. Fl. ed. 1, **3**: 420, *fig. 3895.* 1898; Small, Fl. Southeast. U. S. ed. 1, 1261. 1903, and ed. 2, 1261. 1913; Rob. & Fern. in Gray's Manual, ed. 7, 832. 1908.

Stems usually simple, 6–9 dm. high, sparsely hirsute below, more densely so above, pedicels leafless, becoming somewhat enlarged or flattened near the head; leaves oblong-lanceolate to long-elliptical, entire, dark green, hirsute on both surfaces, triple-veined, medium in texture; basal leaves 1.8–3.1 dm. long, 1–3.5 cm. broad, the cauline 10–27 cm. long, 1–2.5 cm. broad, acute; involucral bracts lanceolate or narrowly oblong, 8–17 mm. long, 2.5–4 mm. broad, strongly ciliate, hirsute, often gradually passing into the echinaceous pales; rays strongly reflexed, 4–9 cm. long, 5–8 mm. broad, bidentate, purplish; achenes 4 mm. long, glabrous, pappus a toothed crown.

Distribution: dry prairies and barrens, Illinois and Kentucky west to Nebraska, southwest to Texas.

ILLINOIS: Peoria, Peoria Co., June 10, 1912, *Churchill* (M); near Wady Petra, Stark Co., June 25, 1900, *Chase 642* (M); near French Village, St. Clair Co., June 15, 1876, *Eggert* (M).

KENTUCKY: Bowling Green, Warren Co., Aug., 1890, *Price* (M).

IOWA: Iowa City, Johnson Co., *Hitchcock* (M); Columbus Junction, Louisa Co., June, 1925, *Graves* (M); Black Hawk Co., June 18, 1929, *Burk 772* (M); ledges, State Park, Boone Co., June 30, 1926, *Pammel 243* (M).

MISSOURI: Oakwood, Ralls Co., June 21, 1916, *Davis 4185* (M); Winfield, Lincoln Co., June 7, 1916, *Davis 4405* (M); Allenton, St. Louis Co., May 20, 1895, *Letterman* (M); Eureka, May 30, 1900, *Norton* (M); Benton, June 21, 1885, *Wislizenus 196* (M); Pacific, Franklin Co., June 3, 1918, *Greenman 4121* (M); Gray's Summit, Franklin Co., May 25, 1927, *Kellogg* (M); Jefferson Co., May 25, 1896, *Eggert* (M); Potosi, Washington Co., June 6, 1892, *Dewart* (M); Ironton, Iron Co., June 26, 1920, *Palmer 18088* (M); Jerome, Phelps Co., June 1, 1914, *Kellogg 438* (M); Cape Girardeau, Cape Girardeau Co., June 22, 1920, *Palmer 18016* (M); Gainesville, Ozark Co., June 26, 1928, *Palmer 34749* (M); Swan, Taney Co., June 10, 1898, *Bush 149* (M); Galena, Stone Co., May 28, 1914, *Palmer 5783* (M); Eagle Rock, Barry Co., May 26, 1898, *Bush 261* (M); Webb City, Jasper Co., June 22, 1902, *Palmer 178* (M); Nichols' Junction, Greene Co., June 15, 1898, *Bush 38* (M); Sheffield, Jackson Co., June 26, 1894, *Bush 156* (M).

ARKANSAS: near Mandelville, Miller Co., June 10, 1898, *Eggert* (M); near Texarkana, June 8, 1898, *Eggert* (M); Fulton, Hempstead Co., June 19, 1915, *Palmer 8061* (M).

LOUISIANA: Jennings, Jefferson Davis Parish, May 15, 1915, *Palmer 7632* (M).

NEBRASKA: Lincoln, Lancaster Co., June 11, 1900, *Hedgcock* (M).

KANSAS: Cowley Co., June, 1898, *White* (M); Caney, Montgomery Co., June 29, 1929, *Rydberg & Imler 400* (M).

OKLAHOMA: Page, Leflore Co., June 20, 1914, *Blakley 1436* (M).

TEXAS: Willis, Montgomery Co., June, *Warner* (M); Houston, Harris Co., June 2, 1915, *Fisher* (M); near Buchanan, Bowie Co., June 13, 1898, *Eggert* (M); Mineola, Wood Co., June, *Reverchon 2072* (M); Dallas, Dallas Co., June 26, 1899, *Eggert* (M); Big Sandy, Upshur Co., May 28, 1900, *Reverchon 2579* (M); Hempstead, Waller Co., June 10, 1872, *Hall 330* (M); Weatherford, Parker Co., May 29, 1902, *Tracy 8331* (M); Grapeland, Houston Co., May 26, 1917, *Palmer 12066* (M); Gladwater, Gregg Co., June, *Reverchon* (M); Boerne, Kendall Co., May 22, 1916, *Palmer 9853* (M).

5. **Echinacea paradoxa** (Nort.) Britt. & Brown, Ill. Fl. ed. 2, **3**: 476, *fig. 4459*. 1913.

Brauneria paradoxa Norton in Trans. Acad. Sci. St. Louis **12**: 40. 1902; Rob. & Fern. in Gray's Manual, ed. 7, 832. 1908; Small, Fl. Southeast. U. S. ed. 1, 1261. 1903, and ed. 2, 1261. 1913.

Stems simple, 3.5–8.5 dm. high, stramineous or yellowish-green, sparsely or densely strigose, sometimes tuberculate-

strigose on the peduncles; leaves oblong-lanceolate to long-elliptical, entire, light green, strigose-pubescent on both surfaces, more densely so below, medium in texture; basal leaves long-petiolate, 1–2.5 dm. long, 1–3.2 cm. broad, the cauline .6–3 dm. long, .5–2.5 cm. broad, acute; involucral bracts 7–10 mm. long, 1–4 mm. broad, lanceolate, acute, the outer foliaceous, the inner passing into the pales, smooth, strigose-ciliate; rays 3–7 cm. long, 3–8 mm. broad, yellow; achenes 4–5 mm. high, glabrous, teeth of the pappus-crown equal in length.

Distribution: rocky slopes and barrens, Missouri to Texas.

MISSOURI: Nichols' Junction, Greene Co., June 15, 1898, *Bush 42* (M); James River, Stone Co., June 3, 1914, *Palmer 5844* (M); Swan, Taney Co., June 10, 1898, *Bush 155* (M); near Seligman, Barry Co., June 1, 1926, *Palmer 30397* (M); Eagle Rock, Barry Co., June 4, 1897, *Bush 76* (M); near Gainesville, Ozark Co., June 26, 1928, *Palmer 34714* (M).

OKLAHOMA: Idabel, McCurtain Co., May 18, 1916, *Houghton 3642* (M).

TEXAS: Willis, Montgomery Co., *Warner* (M); Houston, Harris Co., April 29, 1916, *Palmer 9617* (M); Valley of the Trinity River, June 28, 1912, *Ruth 243* (M).

ZALUZANIA Pers.

History.—The genus *Zaluzania* was first published by Persoon[1] in 'Synopsis Plantarum' in 1807; it was based on *Anthemis triloba* Ort., a plant native of Mexico.

Lagasca,[2] in 'Genera et Species Plantarum' in 1816, described the genus *Ferdinanda* and included two species, *F. augusta,* now *Zaluzania augusta,* and *F. eminens,* now *Podachaenium paniculatum* Benth. Cassini,[3] Kunth,[4] DeCandolle,[5] and Endlicher[6] recognized Lagasca's genus in their treatment of the Heliantheae. The generic limitations of *Ferdinanda* were rather broad and included species with or without a pappus, etc., the pappose species now being included in *Podachaenium. Chrysophania* of Kunth[4] is synonymous wth *Ferdinanda,* since its type species *C. fastigiata* is a synonym of *Zaluzania*

[1] Persoon, C. H., Syn. Pl. **2**: 473. 1807.
[2] Lagasca, A. M., Gen. et Sp. Nov. Pl. 31. 1816.
[3] Cassini, M. H., in Dict. Sci. Nat. **46**: 404. 1827.
[4] Kunth, C., in Less. Syn. Gen. Comp. 224. 1832.
[5] De Candolle, A., in DC. Prodr. **5**: 552. 1836.
[6] Endlicher, S., Gen. Pl. 408. 1838.

augusta, the species on which *Ferdinanda* was based. Robinson and Greenman[7] in 1899 treated *Ferdinanda* as a subgenus under *Zaluzania.* This position is retained in the present revision of this genus.

Hybridella was described briefly by Cassini[8] in 'Bulletin des Sciences, par la Societe Philomatique' in 1817, and was based on *Anthemis globosa* Ort. *Hybridella* was never recognized as a genus by other authors. Robinson & Greenman[7] in 'Proceedings of the American Academy' in 1899 treated it as a subgenus under *Zaluzania,* this disposition being retained in the present paper. It comprises those palustrine, herbaceous species of *Zaluzania* with finely dissected leaves. *Chilophyllum* of De Candolle[9] described in the "Prodromus" in 1836 is synonymous with *Hybridella.*

A taxonomic study of *Zaluzania* was published by Schultz-Bipontinus in "Flora" in 1861[10] and 1864.[11] His treatise of 1861 comprised seven species, three of which were new, namely, *Z. megacephala, Z. montagnaefolia,* and *Z. myriophylla.* His publication on the genus in 'Flora,' 1864, included twelve species, eight of which belong to *Zaluzania,* three have been transferred to *Viguiera,* and one to *Calea.*

Between 1864 and 1898 four new species were added to *Zaluzania,* namely, *Z. mollissima, Z. Coulteri, Z. resinosa,* and *Z. discoidea.* The genus now totalled eleven species, all native of Mexico, *Zaluzania Coulteri* having been found to be synonymous with *Z. cinerascens.* The first comprehensive revision of the genus by Robinson and Greenman[7] in 'Proceedings of the American Academy' in 1899 added two new species. The genus, at this time, was known only from Mexico and Arizona.

Hieronymus[12] in Engler's 'Botanische Jahrbücher' in 1900 described three new species from Ecuador. This is the only record of *Zaluzania* from South America; and of these three

[7] Robinson, B. L., and Greenman, J. M., in Proc. Am. Acad. Sci. **34**: 531–534. 1899.

[8] Cassini, M. H., in Bull. Soc. Philom. p. 12. 1817.

[9] De Candolle, A., in Prodr. **5**: 554. 1836.

[10] Schultz-Bipontinus, C. H., in Flora **44**: 561–565. 1861.

[11] Schultz-Bipontinus, C. H., in Flora **47**: 216–220. 1864.

[12] Hieronymus, G., in Engl. Bot. Jahrb. **29**: 35–37. 1900.

species *Z. Sodiroi* is the only one retained in the present monograph; the other two pass into synonymy.

GENERAL MORPHOLOGY

Roots.—The roots of the various suffruticose and shrubby species of the genus are little known, because, due to their bulk, they have not been taken by collectors. This also may apply to the herbaceous species that attain a height of three feet or more. The roots are mostly biennial or perennial in all the species of *Zaluzania.* In *Z. globosa* and its variety the main root is relatively short and rhizome-like with numerous secondary fibrous roots. *Zaluzania Grayana* is the only species known to the author that possesses a thickened tuberous rootstalk surmounted by a slender, lignescent, branched base which gives rise to the suffrutescent stems.

Stems.—The stems of *Zaluzania* are terete and usually more or less striated. They vary from herbaceous to lignescent. The herbaceous type is especially exemplified in *Z. globosa, Z. anthemidifolia, Z. triloba, Z. discoidea,* and *Z. megacephala.* The suffruticose forms are lignescent at their base or upwards for half the height of the plant, the flower-bearing branches being herbaceous. This type may be observed in *Z. Robinsonii* and *Z. Grayana.* The shrubby species are especially exemplified by *Z. Pringlei* and *Z. montagnaefolia.*

Leaves.—Two quite different forms of leaves are displayed in the genus, namely, (1) finely dissected leaves, and (2) undivided or lobed leaves. The former group, comprising species that inhabit moist or swampy localities, as *Z. globosa* and its variety *myriophylla,* often have leaf-segments 3–4-pinnatisect.

The second group is typified by the subgenus Ferdinanda. Three species, namely, *Z. Grayana, Z. triloba,* and *Z. Robinsonii,* have pinnately, or more commonly palmately, lobed leaves. The remaining species display undivided leaves which are ovate, ovate-lanceolate to ovate-elliptical in outline, acute to broadly obtuse, and entire to variously dentate or serrate. The venation is chiefly of the pinnate type, usually with three prominent veins near the base of the leaf. Leaves with pro-

nounced reticulations are exemplified in *Z. Sodiroi,* and to a less degree in *Z. montagnaefolia.*

Pubescence.—The common type of pubescence in *Zaluzania* consists of simple unbranched hairs. The species are all more or less pubescent, except *Z. anthemidifolia,* which is glabrous. The degree and character of this covering vary with the different species. The hirsute type is less common, *Z. globosa* and *Z. triloba* being the best examples. The softer types of trichomes, varying from crispy hirtellous, velutinous, to velvety tomentose, are the most common forms within the genus. The velutinous or velvety tomentose type of pubescence is shown in *Z. augusta, Z. subcordata, Z. mollissima,* and *Z. discoidea.* Short-stiped or sessile, globular, resinous glands are present in the majority of the species.

Inflorescence.—The corymbose to subpaniculate types of inflorescence are dominant for *Zaluzania.* The Hybridella section has a tendency towards the production of heads in very loose panicles, or solitary, as in *Z. anthemidifolia.* The inflorescence is of little significance in separating the species.

The receptacle is conical with persistent pales. The pales are of two sorts, namely, the linear, plane, herbaceous type characteristic of Hybridella, and (2) the complicate or boat-shaped subcoriaceous type as in the subgenus Ferdinanda. The pales are of little importance for specific delimitation but they serve as important subgeneric characters.

Corollas.—All the species of *Zaluzania,* with the exception of *Z. discoidea* and *Z. Pringlei,* have heterogamous flower-heads, with styliferous and fertile ray-flowers, and fertile, tubular disk-florets. The corollas are yellow in both ray- and disk-flowers. The ligules are ovate, oblong-ovate, to oblong, 2–3-denticulate or subentire, always styliferous. The tube in some species is dilated at the base so as to completely cap the achene. The disk-corollas have a narrow cylindrical tube which is about half the length of the corolla proper, and always expanded at the base so as to cap the achene; the throat is campanulate, glabrous or pubescent, with a somewhat spreading five-lobed limb. The expanded base of the corolla and the fer-

tile ray-flowers constitute the major characters of generic importance.

The androecium is composed of five syngenesious stamens with ovate appendages and sagittate bases, which are similar to those of related genera. The style-branches are slender, more or less recurved, with acute or obtuse appendages. Their apices are variously pubescent.

Achenes and Pappus.—The achenes of the disk-flowers are ordinarily linear-cuneate or narrowly oblong and somewhat four-angled; the ray-achenes are triangulate. The disk-achenes are glabrous, the ray-achenes variously pubescent or glabrous. The variation of the achenes within the genus is very slight and consequently of no specific importance. The disk-achenes are devoid of a pappus. The ray-achenes are epappose or crowned by a pappus varying from short-hirsute hairs to fimbriate or squamulose setae.

Geographical Distribution.—The center of distribution for this genus is in the Mexican Plateau. *Zaluzania Grayana* is the most northerly distributed species; it occurs in the mountains of Chihuahua and southern Arizona. The most extra-limital species is *Z. Sodiroi,* known to occur only in the mountains of Ecuador, South America. Five of the fourteen species included in this genus have a limited distribution; for example, *Z. anthemidifolia* is known only from Jalisco; *Z. Pringlei* inhabits limestone hills near Jojutla in the state of Morelos; *Z. cinerascens* is known to occur only among the fir forests of the Sierra Pachuca Mountains in the state of Hidalgo; *Z. megacephala* is found in the mountains of Coahuila at an elevation of 6500–10,000 feet; whereas *Z. subcordata* is an inhabitant of the dry, rocky or barren hills and mountains of southeastern Puebla. *Zaluzania discoidea* and *Z. montagnaefolia* are known to occur only in two states of Mexico; the former inhabits the dry, rocky hills and mountains of Chihuahua and Durango, whereas the latter occupies a similar habitat in the states of Puebla and Oaxaca. The remaining five species occur in central Mexico with a general range from Durango south to the states of Mexico and Hidalgo.

The species of the subgenus Hybridella occur at relatively lower altitudes in palustrine or moist habitats. The species assigned to the subgenus Ferdinanda occur at high altitudes, ranging usually from 5000 to 10,000 feet elevations.

TAXONOMY

Zaluzania Pers. Syn. Pl. **2**: 473. 1807; Less. Syn. Gen. Comp. 224. 1832; DC. Prodr. **5**: 553. 1836; Endl. Gen. Pl. 408. 1838; Walp. Rep. Bot. Syst. **2**: 611. 1843; Schz.-Bip. in Flora **44**: 561–565. 1861; *Ibid.* **47**: 216. 1864; Benth. & Hook. Gen. Pl. **2**: 362. 1873; Hemsl. Biol. Cent.-Am. Bot. **2**: 159. 1881; Hoffm. in Engl. & Prantl, Nat. Pflanzenfam. IV. Abt. 5: 233. 1890; Rob. & Greenm. in Proc. Am. Acad. **34**: 530. 1899; Blake in Contr. U. S. Nat. Herb. [Standley's Trees & Shrubs Mexico] **23**: 1537. 1926.

Ferdinanda Lag. Gen. & Sp. Nov. Pl. 31. 1816; Cass. in Dict. Sci. Nat. **46**: 404. 1827; Kunth in Less. Syn. Gen. Comp. 224. 1832; DC. Prodr. **5**: 552. 1836; Endl. Gen. Pl. 408. 1838.

Hybridella Cass. in Bull. Soc. Philom. 12. 1817; in Dict. Sci. Nat. **22**: 86. 1821.

Chrysophania Kunth in Less. Syn. Gen. Comp. 224. 1832; DC. Prodr. **5**: 553. 1836; Endl. Gen. Pl. 408. 1838.

Chiliophyllum DC. Prodr. **5**: 554. 1836, not *Chiliophyllum* Phil. in Linnaea **33**: 132. 1864; Endl. Gen. Pl. 408. 1838.

Perennial herbs or shrubs, often striated, glabrate, velutinous, tomentulose, or hirsute. Leaves alternate, simple, palmately or pinnately lobed to pinnatisect, entire, serrate to dentate-mucronate, hirsute, strigose-villous, tomentulose to velutinous, frequently interspersed by resinous glands. Heads radiate or discoid, in corymbose, subcorymbose, or subpaniculate clusters, hemispherical to subglobose. Involucre campanulate to subcampanulate, 2–4-seriate, graduated or subequal, the outer bracts sometimes much longer than the inner, ovate, ovate-lanceolate to oblong-lanceolate, herbaceous, the inner series becoming subcoriaceous. Receptacle conical, about 3 mm. high; pales subherbaceous to coriaceous, trilobed or acute at the apex, plane to conduplicate, not deciduous with the achenes. Disk-corollas with the base dilated and capping the

crown of the achene, the tube narrowly cylindrical, expanding above into the campanulate throat and the 5-lobed, spreading or reflexed limb, tube pubescent or glabrous. Stamens sagittate at the base, appendages ovate; style-branches more or less recurved, with obtuse or acute appendages, pubescent at the apex. Ray-corollas yellow, styliferous, the tube often capping the ray-achene. Achenes of the disk-flowers quadrangulate-obcompressed or rhomboidal in cross-section, glabrous, those of the ray-flowers trigonal, glabrous or pubescent; pappus absent in the disk-achenes, absent or consisting of minute fimbriate or squamellose setae in the ray-achenes.

Type species: *Z. triloba* (Ort.) Pers. Syn. Pl. **2**: 473. 1807.

KEY TO THE SUBGENERA

A. Leaves finely pinnatisect; pales linear, plane, herbaceous or subherbaceous; palustrine herbs.......Subgenus Hybridella (Cass.) Rob. & Greenm. Sp. 1–2.

AA. Leaves simple or lobed; pales conduplicate, coriaceous to subcartilaginous; perennial herbs or shrubs of mesophytic or dry habitats.............. ....Subgenus Ferdinanda (Lag.) Rob. & Greenm. Sp. 3–14.

KEY TO THE SPECIES AND VARIETIES

A. Leaves narrowly pinnately dissected or bipinnatisect; pales linear, plane, herbaceous or subherbaceous.

B. Leaves finely 2–4-pinnatisect, the ultimate segments less than 1 mm. broad.

C. Ultimate leaf-segments acute..............................*1. Z. globosa*

CC. Ultimate leaf-segments obtuse............*1a. Z. globosa* var. *myriophylla*

BB. Leaves narrowly pinnate to bipinnate, the ultimate segments 1–2 mm. broad...*2. Z. anthemidifolia*

AA. Leaves undivided or lobed; pales conduplicate, coriaceous or subcoriaceous.

B. Leaves palmately or pinnately lobed.

C. Plants hirsute-hispid or densely hirsutulous; heads 8–20 mm. broad including the rays.

D. Hirsute-hispid; heads 15–20 mm. broad including the rays; leaves bipinnately lobed or cleft; plants herbaceous..............*3. Z. triloba*

DD. Densely crisp-hirtellous; heads 8–12 mm. broad including the rays; leaves 3-lobed or tripartite; plants suffruticose.........*4. Z. Robinsonii*

CC. Plants minutely hirtellous to glabrate; heads 20–30 mm. broad including the rays..*5. Z. Grayana*

BB. Leaves undivided.

E. Heads discoid.

F. Plants shrubby; leaves ovate, strigose-puberulent beneath...... ....*6. Z. Pringlei*

FF. Plants herbaceous from a ligneous base; leaves broadly ovate to deltoid-ovate, velvety tomentose beneath...........*7. Z. discoidea*

EE. Heads radiate.
G. Leaves entire, serrate to crenate-serrate; plants of Mexico.
H. Leaves pustulate-hirsute to pustulate-hispidulous above, crenate-serrate, base decurrent and auriculate *8. Z. montagnaefolia*
HH. Leaves tomentose, velutinous or hirsutulous, base not auriculate.
I. Plants herbaceous or suffruticose, unbranched except in the inflorescence; pappus absent on the ray-achenes.
J. Leaves broadly ovate to ovate-elliptical, 1½ times as long as broad, hirtellous................*9. Z. cinerascens*
JJ. Leaves lanceolate or ovate-lanceolate, about three times as long as broad, velutinous..........*10. Z. megacephala*
II. Plants shrubby, freely branched below; pappus of the ray-achenes a crown of minute lacerate or squamose setae.
K. Heads including the rays 2–3 cm. broad, rays 1–1.5 cm. long; leaf-blades attenuately decurrent to the base of the petiole..............*11. Z. mollissima*
KK. Heads including the rays less than 1.5 cm. broad, rays 5–8 mm. long; leaf-blades subcordate, not decurrent to the base of the petiole.
L. Leaves entire, subcordate, densely tomentose beneath..........................*12. Z. subcordata*
LL. Leaves below the branches of the inflorescence crenate-serrate to coarsely serrate, velutinous beneath.............................*13. Z. augusta*
GG. Leaves mucronate-dentate; plants of South America.*14. Z. Sodiroi*

1. **Zaluzania globosa** (Ort.) Schz.-Bip. in Flora **44**: 564. 1861; Hemsl. Biol. Cent.-Am. Bot. **2**: 159. 1881; Rob. & Greenm. in Proc. Am. Acad. **34**: 530. 1899.

Anthemis globosa Ort. Desc. Pl. 46. 1797; Jacq. Desc. Rar. Pl. **3**: 64, *pl. 372.* 1798.

Hybridella globosa (Ort.) Cass. in Dict. Sci. Nat. **22**: 86. 1821.

Chiliophyllum globosum (Ort.) DC. Prodr. **5**: 554. 1836; Benth. Pl. Hartweg. 17. 1839.

Perennial palustrine herbs; stems 2–5 dm. tall, slender, sulcate, hirsute to pilose-hirsute, also glandular on the peduncles; basal leaves several, oblanceolate in general outline, finely pinnately dissected, often 3–4-pinnatisect, 1–2 dm. long, 2–4 cm. broad, hirsute to pilose-hirsute, and glandular, segments 2–3 mm. long, linear-lanceolate, acute, the petioles pilose-hirsute; stem-leaves few subtending the pedunculate branches, 2 to 8 on naked pedunculate branches, 2–3 cm. broad including the

rays, 6–10 mm. long; bracts of the involucre herbaceous, lanceolate to oblanceolate, 5–6 mm. long, 1.5–2 mm. broad, hirsute-ciliate, acute, hirsute and more or less glandular; pales weak, almost herbaceous, narrowly linear, 3–4 mm. long, 0.5 mm. or less broad, ciliate, obtuse to acute, glandular on the outer surface; disk-flowers densely glandular on the outer surface of the tube; ray-flowers bidentate, 6–12 mm. long including the achene; mature achenes about 2 mm. long, glabrous, pappus absent.

Distribution: low wet meadows and swampy grounds of central Mexico, San Luis Potosi, southeast to the state of Mexico.

MEXICO: SAN LUIS POTOSI—22° N. lat., alt. 6000–8000 ft., 1878, *Parry & Palmer 527* (M); HIDALGO—Telles, Sept. 21, 1910, *Orcutt 4139* (F, M); Pachuca, July, 1903, *Purpus 77* (M, U CAL, US); MEXICO—wet meadows, Valley of Mexico, alt. 7300 ft., June 7, 1901, *Pringle 9395* (G, M, US); low meadows, Valley of Mexico, Federal District, July 27, 1890, *Pringle 3204* (G, M, U CAL, US); uncultivated fields, Valley of Mexico, June 12, 1865–66, *Bourgeau 385* (G, US); damp meadows, alt. 7300 ft., Valley of Mexico, Federal District, June 25, 1897, *Pringle 7440* (US); Valley of Mexico, June 24, 1889, *Pringle 2925* (G); Valley of Mexico, Aug., 1855, *Schaffner 80* (G); wet meadows, alt. 7300 ft., Tlalnepantla, May 15, 1904, *Pringle 13092* (F, G, US); Valley of Mexico, near Tlalnepantla, June 30, 1901, *Rose & Hay 5274* (US); near Tlalnepantla, July 6, 1905, *Rose, Painter & Rose 8417* (US); Valley of Mexico, near Tacubaya, July 30, 1901, *Rose & Hay 5816* (US).

1a. var. **myriophylla** (Schz.-Bip.) W. M. Sharp, comb. nov.

Zaluzania myriophylla Schz.-Bip. in Flora **44**: 565. 1861; Rob. & Greenm. in Proc. Am. Acad. **34**: 530. 1899.

Zaluzania globosa Schz.-Bip. in Hemsl. Biol. Cent.-Am. Bot. **2**: 159. 1881, in part.

Leaves with the ultimate segments finely dissected, linear, short, 1–2 mm. long, obtuse, hirsute to glabrous; habit and floral characters as in the species.

Distribution: central Mexico, Durango, south to the state of Mexico, inhabiting low wet meadows and swamps.

MEXICO: DURANGO—city of Durango and vicinity, 1896, *Palmer 307* (F, G, M, U CAL, US); ZACATECAS—damp hollows and plains at Colera Station, Sept. 1, 1904, *Pringle 8914* (F, G, M, U CAL, US); SAN LUIS POTOSI—San Luis Potosi, 1879, *Schaffner 770 (345)* (G, US); MEXICO—north of Mexico City, 1837, *Hartweg 111* (G).

The short, linear, obtuse, ultimate segments and the glabrous to sparsely hirsute, glandular leaves warrant at least a varietal

recognition. The ultimate segments of *Z. globosa* are lanceolate, 2–3 mm. long, and acute.

2. **Zaluzania anthemidifolia** Rob. & Greenm. in Proc. Am. Acad. **34**: 531. 1899.

Plants herbaceous; stems decumbent, glabrous; leaves pinnate to bipinnate or bipinnatisect, pilose-hirsute on the midrib and petioles, especially the young leaves, the ultimate segments 1–2 mm. broad, obtusish to acute; heads solitary or sometimes 2 or 3 terminating the leafy branches; peduncles 2–5 cm. long; bracts of the involucre obtuse or obtusish; rays about 1 cm. long, bifid, tube and outer surface of the lamina glandular; disk-corollas with a narrow glandular tube; achenes glabrous; pappus absent.

Distribution: wet sandy banks of the Rio de Santiago River, near Guadalajara, Jalisco.

MEXICO: JALISCO—wet sandy river banks, near Guadalajara, Sept. 23, 1891, *Pringle 5156* (G TYPE); wet sandy banks of the Rio Grande de Santiago, barranca near Guadalajara, Oct. 12, 1895, *Pringle 7367* (F, M, U CAL).

3. **Zaluzania triloba** (Ort.) Pers. Syn. Pl. **2**: 473. 1807; Kunth in Less. Syn. Comp. 225. 1832; DC. Prodr. **5**: 553. 1836; Schz.-Bip. in Flora **44**: 564. 1861; Hemsl. Biol. Cent.-Am. Bot. **2**: 160. 1881; Rob. & Greenm. in Proc. Am. Acad. **34**: 531. 1899.

Anthemis triloba Ort. Desc. Pl. Rar. 72. 1800.

Anthemis trilobata Willd. Sp. Pl. **3**^{3}: 2186. 1804.

Anthemis sinuata LaLlave & Lexarza, Nov. Veg. Desc. **1**: 26. 1824.

Herbaceous plants; stems about 6 dm. tall, often irregularly bluish-purple below, branched above, hirsute-hispid; leaves dark green, broadly pinnately parted, including the petiole 2–16 cm. long, 1–5 cm. broad, the segments acute to obtuse, the basal divisions cleft almost to the midrib, the terminal divisions deeply cleft; main cauline leaves long-petiolate, light green beneath and somewhat glandular, densely hirsute-hispid to hirsute especially on the veins, dark green and hirsute-hispid to strigose-hirsute above; inflorescence subcorymbose or subpaniculate; mature heads, including the rays, 1.5–2 cm. broad,

6–10 mm. high, peduncles 2–5 cm. long; bracts of the involucre 2-seriate, narrowly oblong-lanceolate to lanceolate, acute, hirsute, the outer series greenish, about twice as long as the inner, the inner ones much paler; corolla 2.5 mm. long, the tube glandular, the throat pubescent; rays oblong, 8–10 mm. long, 3–5 mm. broad, pubescent on the outer surface; disk-achenes 2 mm. long, glabrous, epappose, ray-achenes pubescent, bearing a crown of a few bristle-like hairs.

Distribution: calcareous mesas at an elevation of 5000 to 8500 ft., San Luis Potosi and eastern Zacatecas, south to Puebla.

MEXICO: SAN LUIS POTOSI—22° N. lat., alt. 6000–8000 ft., 1887, *Parry & Palmer 445* (F, G, M, US); San Luis Potosi, alt. 5950 ft., Aug. 22, 1926, *Fisher 136* (US); ZACATECAS—near Guadalupe, Aug., 1855, *Schaffner 78* (G); Guadalupe, 1865–66, *Bourgeau 704* (G, US); alt. 8000 ft., Aug. 8, 1898, *Deam 137* (F, G); city of Zacatecas, *Palmer 757* (G); GUANAJUATO—Sept., 1891, *Duges 460* (G); Jaral, 1885, *Schumann 94 (335)* (US); QUERETARO—from "Cierro to San Juan," Aug. 27, 1905, *Altamirano 1744* (US); HIDALGO—Telles, Sept. 21, 1910, *Orcutt 4131* (F, M); Pachuca, Sept. 5, 1910 *Orcutt 3902* (F, M, US); Sierra de Pachuca, alt. 9000 ft., July 21, 1901, *Pringle 9481* (F, G, M, US); calcareous mesas, near Zontecomate, alt. 8500 ft., June 22, 1904, *Pringle 13093* (F, G, US); near Tula, July 3–4, 1905, *Rose, Painter & Rose 8325* (US); PUEBLA—Orizaba Mts., *Botteri 843* (G, US).

4. **Zaluzania Robinsonii** W. M. Sharp, sp. nov.[13]

Plants suffruticose; stems 3–7 dm. tall, woody below, herbaceous and branched above, sulcate by alternating light green ridges and green grooves, canescent, densely crisp-hirtellous, especially above, sparsely and minutely glandular; leaves petiolate, including the petiole 1.5–6 cm. long, 1–4 cm. broad, of medium texture, crisp-hirtellous and minutely glandular on both surfaces, palmately 3-lobed or tripartite, lobes acute or acutish, subcordate, the anterior lobes divided or sometimes pinnatifid; heads few, in close corymbose clusters, including the rays 8–12 mm. broad, about 5 mm. high, the peduncles of

[13] **Z. Robinsonii** Sharp, sp. nov. Plantae suffruticosae; caulibus 3–7 dm. altis, infra ligneis, supra herbaceis et ramosis, canescentibus, dense crispo-hirtellis; foliis palmater 3-lobatis vel tripartitis, petiolis includentibus 1.5–6 cm. longis, 1–4 cm. latis, lobis acutis, subcordatis, supra et subtus crispo-hirtellis; capitulis radiis includentibus, 8–12 mm. latis, 5 mm. altis; radiis 5–6 mm. longis, tubo dense villoso.—Collected at Cedros, Zacatecas, Mexico, *F. E. Lloyd 124* (M TYPE).

the corymb short, 0.5–3 cm. long; bracts of the involucre 2-seriate, linear-lanceolate, 3 mm. long, acute, ciliate, pubescent; corolla 2.5–3 mm. long, the tube and throat pubescent; rays 5–6 mm. long, tube densely villous; achenes of the disk-flowers glabrous, epappose, ray-achenes cuneate-obovate, densely villous, with a crown of long-villous silky hairs.

Distribution: usually in shade of larger shrubs, hills and mountain slopes of Coahuila south to Zacatecas and Hidalgo.

Mexico: coahuila—valley of Nazar, Bolson de Mapimi, May 11, 1847, *Gregg 631* (M); valley of Nazar, Bolson de Mapimi, collection of 1848–49, *Gregg 447* (G); Parras, 111 miles west of Saltillo, June 18–28, 1880, *Palmer 592* (G, US); Saltillo, June, 1898, *Palmer 360* (F, G, M, U CAL, US); near Saltillo, Nov. 10–20, 1902, *Palmer 279* (F, G, M, US); Parras, 1905, *Purpus 1126* (F, U CAL); Parras, Oct. 6–11, 1898, *Palmer 435* (G, M, U CAL, US); Carneros Pass, Sept. 7, 1889, *Pringle 2402* (F, G, M, U CAL, US); La Ventura, Aug. 2–5, 1896, *Nelson 3930* (G, US); zacatecas—Cedros, northern Zacatecas, June, 1908, *Kirkwood 67* (G); in shade of shrubs, vicinity of Cedros, Aug., 1908, *Kirkwood 227* (F); in shade of larger plants, such as mesquite, Cedros, Aug., 1909, *Lloyd 124* (M type); san luis potosi—between the states of Nuevo Leon and Matehuala, June 17–18, 1898, *Nelson 4520* (US); region of San Luis Potosi, Sept. 1879, *Schaffner 717 (286)* (F, US); hidalgo—mountain slopes, Ixmiquilpan, Sept. 1905, *Purpus 1334* (F, G, M, U CAL).

5. **Zaluzania Grayana** Rob. & Greenm. in Proc. Am. Acad. **34**: 531. 1899; Woot. & Standl. in Contr. U. S. Nat. Herb. [Fl. N. Mex.] **19**: 708. 1915; Blake in Contr. U. S. Nat. Herb. [Standley's Trees & Shrubs Mexico] **23**: 1537. 1926.

Gymnolomia triloba Gray in Proc. Am. Acad. **17**: 217. 1882.

Zaluzania Grayiana Rob. & Greenm. in Proc. Boston Soc. Nat. Hist. **29**: 104. 1899.

Suffruticose; stems from a lignescent rootstock, 4–8 dm. high, branched above, minutely hirtellous to glabrate; leaves petiolate, ovate to 3-lobed, 3–9 cm. long, 1.5–6 cm. broad, the lobes sparsely incised to incised-serrate, acute, minutely hirtellous on both surfaces; heads in loose corymbose clusters, 2–3 cm. broad including the rays, 6–8 mm. high; bracts of the involucre linear-lanceolate, 4 mm. long, minutely hirtellous; pales subcoriaceous, conduplicate, trifid at the apex, ciliate, hirsutulous along the dorsal ridges; ray-flowers 7–10, rays oblong, 0.8–1.5 cm. long, disk-flowers 2 mm. long, the tube hirsutulous, the limb glabrous; achenes of the disk-corollas 2 mm.

long, triangular, epappose, ray-achenes bearing a crown of a few short squamellose setae.

Distribution: mountains of southern Arizona south to Chihuahua.

UNITED STATES: ARIZONA—peaks south of Rucker Valley, 1881, *Lemmon* (G TYPE); near Fort Huachuca, high peaks of Huachuca Mts., Aug.–Sept., 1882, *Lemmon 2764* (F, G, US); Huachuca Mts., July 3, 1884, *Pringle 2145* (G, US); near Ft. Huachuca, Sept., 1894, *Wilcox 469* (US); high peaks of Huachuca Mts., Aug.–Sept., 1882, *Lemmon* (US); north slope of Huachuca Mts., Carr Peak, Aug. 25, *Goodding 864* (G); Apache Pass, Chiricahua Mts., Sept., 1881, *Lemmon* (M).

MEXICO: CHIHUAHUA—shaded ravines, Mapula Mts., alt. 6000 ft., Oct. 30, 1886, *Pringle 755* (F, G, M, US); shaded slopes, La Bufa Mt. above Cusihuiriache, Sept. 2, 1887, *Pringle 1310* (F, G, US).

6. **Zaluzania Pringlei** Greenm. in Proc. Am. Acad. **39**: 101. 1903; Blake in Contr. U. S. Nat. Herb. [Standley's Trees & Shrubs Mexico] **23**: 1538. 1926.

Plants shrubby; stems of the more woody parts covered with a grayish bark, the ultimate branches purplish, striate, lenticular, especially so below, strigose-puberulent above, becoming glabrate below; leaves petiolate, ovate, 3–5.5 cm. long, 1.5–3.5 cm. broad, short-acuminate, acute or submucronate-acute, entire to crenate-dentate, strigose puberulent on both surfaces, petioles slender, 0.5–1.5 cm. long; heads discoid, ovate, grouped in a terminal round-topped paniculate-corymbose cluster, 5–7 mm. high, 5–6 mm. wide; bracts of the involucre 3-seriate, ovate-lanceolate, about 3 mm. long, acute, strigose-puberulent; pales coriaceous, pubescent; achenes 2 mm. long, glabrous, pappus absent.

Distribution: limestone hills of Morelos.

MEXICO: MORELOS—limestone hills near Jojutla, alt. 3000 ft., Oct. 18, 1902, *Pringle 8710* (F, G, M, U CAL, US).

7. **Zaluzania discoidea** Gray in Proc. Am. Acad. **21**: 388. 1886; Rob. & Greenm. in Proc. Am. Acad. **34**: 534. 1899.

Plants herbaceous from a lignescent base; stems 6–10 dm. tall, simple, terminated by a corymbose cluster, striate, purplish, velutinous; leaves short-petiolate, broadly ovate, round-ovate to deltoid-ovate, 4–12 cm. long, 3–10 cm. broad, irregularly crenate to crenate-undulate, obtuse to acute, subcordate

to broadly cordate at the base, palmately veined, pale green above, strigose-velutinous to strigose-hirtellous, whitish beneath, velvety tomentose; heads discoid, in dense corymbose clusters, subglobose, 5–7 mm. broad, 6 mm. high; bracts of the involucre herbaceous, ovate-lanceolate, about 4 mm. long, acute, hirtellous; pales coriaceous, acute, fimbriate; corolla-tube minutely puberulent; achenes about 2.5 mm. long at maturity, glabrous, epappose.

Distribution: rocky hills and mountains of Chihuahua and Durango.

MEXICO: CHIHUAHUA—mountains near Chihuahua, Sept. 12, 1886, *Pringle 1110* (M, U CAL); rocky hills near Chihuahua, Oct. 19, 1885, *Pringle 309* (F, G, US); "Cosiquiriache," Sept. 25, 1846, *Wislizenus 189* (M); DURANGO—El Oro to Guanacevi, Aug. 14–16, 1898, *Nelson 4727* (US); along road between "Cerro Prieto and La Providencia," Sept. 11, 1898, *Nelson 4970* (US).

8. **Zaluzania montagnaefolia** Schz.-Bip. in Flora **44**: 563. 1861; Hemsl. Biol. Cent.-Am. Bot. **2**: 160. 1881; Blake in Contr. U. S. Nat. Herb. [Standley's Trees & Shrubs Mexico] **23**: 1538. 1926.

Ferdinanda montagnaefolia Schz.-Bip. in Koch's Berl. Allgem. Gartenz. 179. 1858.

Zaluzania asperrima Schz.-Bip. in Flora **47**: 218. 1864; Hemsl. Biol. Cent.-Am. Bot. **2**: 159. 1881; Rob. & Greenm. in Proc. Am. Acad. **34**: 532. 1899.

Zaluzania asperrima var. *montagnaefolia* (Schz.-Bip.) Rob. & Greenm. in Proc. Am. Acad. **34**: 532. 1899.

Plants shrubby; stems glabrate below, strigose-hirtellous above; leaves ovate, 2–7 cm. long, 1–3 cm. broad, serrate or crenate-serrate to often entire above, acuminate to acuminate-acute, base decurrent-attenuate, auriculate, leaves of corymbose branches sessile and auriculate, above dark green, pustulate-hispidulous to pustulate-hirsute, beneath light green, densely resinous-glandular and hirsute especially on the veins; heads in corymbose clusters, 1–1.5 cm. broad including the rays; bracts of the involucre 3–4-seriate, ovate, 3–4 mm. long, ciliate, acute to acuminate, hirsutulous; pales subcoriaceous, strongly incurved and united above, the apex resembling the prow of a canoe; ray-flowers styliferous and fertile, 6–8 mm.

long including the achene, base of tube capping the achene; achenes 1.5–2 mm. long, disk-achenes obcompressed-quadrangular, ray-achenes trigonous, glabrous, epappose.

Distribution: dry hills and barrens of Puebla and Oaxaca.

MEXICO: PUEBLA—"dry hills," Tlacuilotepec, Aug., 1909, *Purpus 3824* (F, G, M, U CAL, US); barrens near Tlacuilotepec, May, 1909, *Purpus 3823* (F, G, M, US); Tehuacan, Sept., 1911, *Purpus 5610* (F, M, U CAL); near Tehuacan, Aug. 1, 1901, *Rose & Hay 5954* (US); near Tehuacan, Nov. 7, 1903, *Holway 5347* (G); "in vicinity of San Luis Tultitlanapa near Oaxaca," Aug., 1908, *Purpus 2530* (F, G, M, U CAL, US); OAXACA—"Monte Alban," near Oaxaca, alt. 5800 ft., Oct. 4, 1894, *Pringle 4928* (G, M, U CAL, US); "Monte Alban near Oaxaca City," alt. 5500–5600 ft., Oct. 2, 1894, *Smith 612* (M); "Distrito de Tlacolula, Magdalene Ecatepac," alt. 1700 m., Oct. 23, 1924, *Conzatti 4601* (US); "Cerro de Trujono," *Conzatti 2317* (F).

9. **Zaluzania cinerascens** Schz.-Bip. in Flora **47**: 219. 1864; Blake in Contr. U. S. Nat. Herb. **26**: 249. 1930.

Zaluzania Coulteri Hemsl. Diagn. Sp. Nov. 33. 1879; Biol. Cent.-Am. Bot. **2**: 159. 1881; Rob. & Greenm. in Proc. Am. Acad. **34**: 533. 1899; Blake in Contr. U. S. Nat. Herb. [Standley's Trees & Shrubs Mexico] **23**: 1538. 1926.

Stems suffrutescent at base, apparently simple to the leafy-bracted corymb, conspicuously striate, densely strigulose-hirtellous; leaves broadly ovate to broadly ovate-elliptical, above dark green, strigulose-puberulent, beneath pale green, densely strigose-hirtellous; main cauline leaves 4–13 cm. long, 2–9 cm. broad, becoming smaller above, entire or sparsely serrulate, obtusely acute; heads in corymbose clusters, when mature 1.5–2 cm. broad including the rays, 6–7 mm. high; involucre subhemispherical; bracts oblong-ovate, 4–5 mm. long, acute to obtusish, strigose-pubescent; pales truncate-obtuse, pubescent towards the apex; ray-flowers broadly oblong to oblong, about 1–1.2 cm. long including the achene, 4–6 cm. broad, puberulent on the outer surface; achenes 2 mm. long, glabrous, epappose.

Distribution: fir forests of the Sierra de Pachuca Mts. of Hidalgo at an elevation of 9000 ft. or above.

MEXICO: HIDALGO—Real del Monte, *Coulter 350* (G TYPE); "El Chico," Sept., 1929, *Lyonnet 387* (US); Sierra de Pachuca, alt. 9500 ft., Oct. 6, 1899, *Pringle 7923* (G, US); Sierra de Pachuca, alt. 9500 ft., Aug. 28, 1906, *Pringle 13784* (G, US);

fir forests, Sierra de Pachuca, alt. 9500 ft., Aug. 26, 1902, *Pringle 9997* (F, G, M, US); Sierra de Pachuca, alt. 9000 ft., Aug. 13, 1898, *Pringle 6956* (F, G, M, U CAL, US).

10. **Zaluzania megacephala** Schz.-Bip. in Flora **44**: 563. 1861; *Ibid.* **47**: 218. 1864; Hemsl. Biol. Cent.-Am. Bot. **2**: 159. 1881, in synonymy; Rob. & Greenm. in Proc. Am. Acad. **34**: 533. 1899; Blake in Contr. U. S. Nat. Herb. [Standley's Trees & Shrubs Mexico] **23**: 1538. 1926.

Ferdinanda augusta var. *megacephala* Schz.-Bip. in Flora **44**: 563. 1861.

Plants herbaceous from a perennial rootstalk; stem 6–10 dm. tall, unbranched except in the inflorescence, striate, glabrate below, densely strigose-hirtellous or velutinous above; leaves lanceolate to ovate-lanceolate, 6–10 cm. long, 2–5 cm. broad, serrate, acute, sessile or subsessile, above green, strigose-hirtellous, beneath cinereous, densely strigose-hirtellous to velutinous; heads in corymbose clusters, 1.5–2.5 cm. broad including the rays, 0.8–1.2 cm. high; bracts of the involucre lanceolate, 4–5 mm. long, ciliate, acute to obtuse, puberulent; pales about 5 mm. long, apex acute, slightly incurved; ray-flowers broadly to narrowly oblong, 8–10 mm. long, 3–4 mm. broad; achenes glabrous, 3 mm. long, epappose.

Distribution: mountains of Coahuila.

MEXICO: COAHUILA—mountains near General Zepeda, alt. 6500 ft., Oct. 7, 1905, *Pringle 10076* (F, G, M, U CAL, US); high summits, near Carneros Pass, alt. 10000 ft., Sept. 8, 1889, *Pringle 2398* (F, G, M, U CAL, US); elevated portion of Sierra Madre, 12–14 leagues south of Saltillo, July 25–Aug. 1, 1880, *Palmer 734* (F, G, US).

11. **Zaluzania mollissima** A. Gray in Proc. Am. Acad. **15**: 35. 1880; Hemsl. Biol. Cent.-Am. Bot. **2**: 160. 1881; Rob. & Greenm. in Proc. Am. Acad. **34**: 532. 1899; Blake in Contr. U. S. Nat. Herb. [Standley's Trees & Shrubs Mexico] **23**: 1538. 1926.

Shrubby; stems branched, about 0.5–1.5 m. high, bark grayish-brown, tomentulose above, the more woody parts glabrate; leaves ovate, ovate-lanceolate to oblong-lanceolate, sometimes tending to become trilobed, 2–5 cm. long, 0.5–2.2 cm. broad, entire, obtuse, acute at the base and decurrent on the petiole,

above dark green, tomentulose, beneath cinereous, densely tomentulose; heads three to several in spreading corymbose or paniculate clusters, 2–3 cm. in diameter including the rays, peduncles 1–7 cm. long; bracts of the involucre oblong-ovate, about 4 mm. long, obtuse to acute, velvety tomentose; pales cartilaginous, slightly trilobate; ray-flowers oblong-lanceolate, 1–1.5 cm. long, 3–4 mm. broad, rays bidentate; achenes of the disk glabrous, epappose, ray-achenes slightly pubescent, bearing a crown of short hirsute hairs.

Distribution: in moist soil in fields or among the hills, from Zacatecas to San Luis Potosi.

MEXICO: ZACATECAS—low places, especially where there is relatively abundant moisture, Cedros, May, 1908, *Lloyd 129* (US); hills, Cedros, June, 1908, *Lloyd 32* (G); vicinity of Cedros, 1908, *Kirkwood 129* (F); near Concepcion Del Oro, Aug. 11–14, 1904, *Palmer 314* (F, G, M, U CAL, US); SAN LUIS POTOSI—vicinity of San Luis Potosi, Aug., 1878, *Parry 446* (F, G TYPE, M, US); in fields near "San Miguel," Aug., 1876, *Schaffner 767 (342)* (F, G, US).

12. **Zaluzania subcordata** W. M. Sharp, sp. nov.[14]

Plants suffruticose; stems branched above, about 0.5–2 m. high, the bark grayish, glabrate below, densely subtomentulose in the inflorescence; leaves broadly ovate to ovate-lanceolate with slender petioles, 1.5–6 cm. long, 0.6–2.5 cm. broad, entire, obtuse, subcordate, above dull green, subtomentose, beneath whitish, densely velvety tomentose, subcoriaceous; heads in close corymbose clusters, 1–1.5 cm. broad including the rays, 6–8 mm. high, peduncles short, 0.5–4 cm. long; bracts of the involucre broadly oblong-lanceolate, 3–4 mm. long, densely tomentulose, whitish; pales trilobed at the summit and fimbriate-ciliate, the outer upper surface pubescent; ray-flowers ovate to oblong-ovate, 5–8 mm. long, 3–4.5 mm. wide, rays faintly bi- or tri-dentate; mature achenes 2–2.5 mm. long,

[14] **Z. subcordata** Sharp, sp. nov. Plantae suffruticosae, caulibus supra ramosis, 0.5–2 m. altis, infra glabratis, dense subtomentosis in inflorescentia; foliis late ovatis vel ovato-lanceolatis, 1.5–6 cm. longis, 0.6–2.5 cm. latis, integris, obtusis, subcordatis, supra obscure viridibus, subtus albidis, dense velutino-tomentosis, subcoriaceis, petiolis gracilibus; capitulis corymbosis, 1–1.5 cm. latis includentibus radiis; radiis ovatis vel oblongo-ovatis, 5–8 mm. longis, 3–4.5 mm. latis.—Collected on rocky hills, Esperanza, Puebla, Mexico, 1907, *Purpus 2580* (F, G, M TYPE, U CAL).

disk-achenes rhomboidally 4-angled, glabrous, epappose, ray-achenes trigonal, pubescent on the ridges, bearing a more or less definite fimbriate-setose or lacerate-setose pappus.

Distribution: rocky or barren hills and mountains of south-eastern Puebla.

MEXICO: PUEBLA—rocky hills, Esperanza, Aug., 1907, *Purpus 2580* (F, G, M TYPE, U CAL, US); barren hills about Esperanza, alt. 2660 m., Aug. 17, 1905, *Pittier 452* (US); Esperanza, alt. 2450 m., Nov. 16–19, 1907, *Arsène 7093* (US); Mt. Orizaba, alt. 9000 ft., Aug. 9, 1891, *Seaton 286* (F, G, US); vicinity of San Luis Tultitlanapa near Oaxaca, Aug., 1908, *Purpus 3027* (F, G, M, U CAL, US); Coxcatlan, alt. 8000–9000 ft., Sept., 1909, *Purpus 4121* (U CAL).

13. **Zaluzania augusta** (Lag.) Schz.-Bip. in Flora **44**: 562. 1861; Rob. & Greenm. in Proc. Am. Acad. **34**: 532. 1899; Blake in Contr. U. S. Nat. Herb. [Standley's Trees & Shrubs Mexico] **23**: 1537. 1926.

Ferdinanda augusta Lag. Gen. & Sp. Nov. Pl. 31, *pl. 2.* 1816; DC. Prodr. **5**: 552. 1836.

Anthemis lutescens La Llave & Lexarza, Nov. Veg. Desc. **1**: 26. 1824.

Chrysophania fastigiata Kunth in Less. Syn. Gen. Comp. 224. 1832; DC. Prodr. **5**: 553. 1836.

Ferdinanda lutescens (La Llave & Lexarza) DC. Prodr. **5**: 553. 1836.

Zaluzania angusta Schz.-Bip. in Hemsl. Biol. Cent.-Am. Bot. **2**: 159. 1881.

Plants fruticose; stems 1.5–2.5 m. tall, bark exfoliating, strigose-velvety and glandular on the branches above; leaves ovate to ovate-lanceolate, 2–8 cm. long, 1–3.5 cm. broad, sessile to subsessile above, short-petiolate below, above densely strigose-velutinous, beneath densely cinereous-velvety, lower cauline leaves crenate-serrate, acute at the base, those of the branches entire, acute to acuminately acute; heads numerous, in corymbose clusters, 5–7 mm. broad not including the rays; involucre campanulate, bracts ovate-lanceolate, about 3 mm. long, ciliate, acute, finely strigose; pales subcoriaceous, apex acute and fimbriate-lacerate to somewhat entire; ray-flowers 7–8 mm. long, oblong, bidentate; achenes about 2 mm. long, ray-achenes trigonal, bearing a crown of squamulose setae, disk-achenes rhomboidal in cross-section, glabrous, epappose.

Distribution: rocky mountain slopes and hills, Guanajuato east to Hidalgo and south to Mexico.

MEXICO: GUANAJUATO—"vicinity of Guanajuato," 1895, *Duges 469* (G); QUERETARO—"Cerro de las companas," alt. 1850 m., July 9, 1914, *Arsène 10065* (G, M, US); collected between Cadereyta and Visaron, Aug. 22, 1905, *Rose, Painter & Rose 9738* (G, US); vicinity of Queretaro, alt. 1850 m., 1909–12, *Arsène & Nicolas 6162* (G, M, US); HIDALGO—between Pachuca and Real del Monte, Aug. 31, 1903, *Rose & Painter 6675* (US); near Pachuca, 1899, *Duges* (US); rocky mountain slopes, near Pachuca, Sept., 1905, *Purpus 1539* (F, G, M, U CAL); hills near Tula, alt. 6800 ft., Oct. 14, 1902, *Pringle 9996* (F, G, M, US); MEXICO—hills near Lecheria Station, alt. 7500 ft., Nov. 18, 1903, *Pringle 11614* (G, US); hills near Lecheria, alt. 7600 ft., Aug. 23, 1904, *Pringle 13091* (F, G, US); Rio Hondo Canyon, Aug. 22, 1890, *Pringle 3144* (F, G, M, U CAL, US); near Tlalnepantla, July 6, 1905, *Rose, Painter & Rose 8418* (US); hills near Mexico City, Sept. 5, 1897, *Pringle 7451* (M); "near Guadelupe," Valley of Mexico, Sept. 23, 1903, *Rose, Painter & Rose 7278* (US); "near Guadelupe," Aug. 24, 1865–66, *Bourgeau 803* (G, US).

14. **Zaluzania Sodiroi** Hieron. in Engl. Bot. Jahrb. **29**: 35. 1900.

Zaluzania nonensis Hieron. *l.c.* **29**: 36. 1900.

Zaluzania quitensis Hieron. *l. c.* **29**: 37. 1900.

Plants suffruticose; stems 1–2 m. tall, brownish to purplish pilose-tomentulose, becoming crisp-hirtellous to glabrate; leaves deltoid-ovate, ovate, to ovate-lanceolate, 4–10 cm. long, 2–6 cm. broad, triple-nerved, dentate-mucronate to subentire, acute, base cuneately decurrent on the petiole, above dark green, rugose, scabrate-hirsute, beneath light green, conspicuously reticulate, densely crisp-hirtellous on the veins, globular-resiniferous; heads in corymbose to subcorymbose clusters, 1–1.2 cm. broad including the rays, pedicels 1–2 cm. long; bracts of the involucre triangulate-ovate, obtuse, crisp villous-tomentulose; ray-flowers yellow, oblong, 5–7 mm. long; achenes rhomboidal in cross-section, linear, 2.5–3 mm. long, slightly incurved at the base, glabrous, pappus absent.

Distribution: Ecuador.

SOUTH AMERICA: ECUADOR—arid interandean hills, *Sodiro 31/1* (US ISOTYPE); near Nono, "in silvis subandinis," *Sodiro 31/2* (US); in hills near Quito, *Sodiro 31/3* (US); 4 ft. high, Aug. 28, 1920, near Quito, *Holway 948* (US); Ficoa, near Ambato, Feb., 1919, *Pachano 134* (US); Ambato, *André K1243* (NY); Province of Pichincha, between "La Magdalena and Chillogallo," alt. 2800 m., July 14, 1927, *Firmin 140* (US); Province of Pichincha, between "La Magdalena and Chillogallo," alt. 2810 m., April 19, 1928, *Firmin 471* (US); Province of Chimborazo,

alt. 3000 m., *André K1245* (NY); near Quito, Aug. 1898, *Mille 558* (NY); near Quito, Aug., 1898, *Mille 568* (NY); frequent near "Pifo," alt. 2600 m., 1895, *Mille 569* (US).

Balsamorhiza Hooker

History—Hooker[1] in 'Flora Boreali-Americana' in 1834 described two species of *Heliopsis,* namely, *H. ?balsamorhiza* and *H. ?terebinthacea.* However, he doubted their generic position and proposed *Balsamorhiza* as a more appropriate name, due to the abundance of a limpid juice, similar to the resin of *Pinus balsamea,* which exuded from their freshly cut or broken roots. The proposal of this genus is accompanied by a narration of its outstanding characters. DeCandolle[2] and Endlicher[3] treated *Balsamorhiza* as a subgenus under *Heliopsis.*

Nuttall[4] in 1841 gave the first comprehensive study of the genus. Following his generic description he included eight species, namely, *Balsamorhiza Hookeri, B. terebinthacea, B. sagittata, B. helianthoides, B. hirsuta, B. incana, B. macrophylla,* and *B. deltoidea;* the four last being new species. *Balsamorhiza sagittata* and *B. helianthoides* were originally described by Nuttall[5] under *Espeletia.* All the above-named species remain valid except *B. helianthoides* which is synonymous with *B. sagittata.* The genus was divided by Nuttall into two subgenera, namely, Artorhiza and Eubalsamorhiza.

Torrey and Gray[6] and Walpers[7] followed Nuttall's treatment in that they recognized about seven or eight valid species as well as the two subgenera Artorhiza and Eubalsamorhiza.

In 1848 *Balsamorhiza Careyana* was published by Asa Gray[8] in 'Memoirs of the American Academy.' In his 'Synoptical Flora'[9] in 1884 he recognized eight species and one variety. He also introduced the subgenus Kalliactis for those

[1] Hooker, W. J., Fl. Bor.-Am. 1: 310. [1834] 1840.
[2] DeCandolle, A., Prodr. 5: 551. 1836.
[3] Endlicher, S., Gen. Pl. 408. 1838.
[4] Nuttall, T., in Trans. Am. Phil. Soc. II, 7: 349. 1841.
[5] Nuttall, T., in Jour. Acad. Nat. Sci. Phila. 7: 38–39. 1834.
[6] Torrey, J., & Gray. A., Fl. N. Am. 2: 300. 1842.
[7] Walpers, G. G., Rep. Bot. Syst. 2: 610. 1843.
[8] Gray, A., in Mem. Am. Acad. [Pl. Fendl.] N.S. 4: 81. 1848.
[9] Gray, A., Syn. Fl. N. Am. 1[2]: 265. 1884.

species possessing chartaceous rays. This character is not always constant, and therefore his subgenus becomes synonymous with Artorhiza. Between 1890 and 1930 four new species were added to *Balsamorhiza* from the northwestern United States.

GENERAL MORPHOLOGY

Roots.—*Balsamorhiza* develops a fusiform, perennial tap-root with a rough, corrugated, bark-like covering. The inner structure is usually composed of a soft, spongy, woody tissue which secretes a terebinthine, resinous juice when freshly cut or broken. The older roots have a tendency to become more woody. The younger roots of some species, especially in late winter or early spring, have been used as articles of food.

The greatest root development is found in the subgenus Artorhiza. The tap-root is often three feet in length, as in *B. sagittata* and *B. deltoidea.* In these species the crown often develops several underground, horizontal branches. In Eubalsamorhiza the root system is less developed. It consists of a slender tap-root, unbranched above, and usually less than two feet in length. The extensive tap-root system, according to ecological investigations, often extends six feet or more below the surface of the soil, and enables these plants to occupy dry open uplands.

Stem.—It is difficult to say definitely from external examination just where the root ends and the underground stem begins, but according to stelar evidence the crown of the tap-root may be designated as stem. The length of this, however, varies from a few to several inches. The lateral underground branches which are developed especially in *B. sagittata* and *B. deltoidea* originate from a region near the main crown. The development of several such branches from one root gives the plant a close bushy or clumpy habit. In a majority of the species of *Balsamorhiza* the crowns are covered by a dense tuft of persistent, fibrous petiole bases of previous seasons.

The aerial, erect or ascending stems develop each season from the underground crowns. The average height is usually 2–4 dm. The minimum is about 1 dm., as in *B. serrata* and *B.*

hispidula, and the maximum height of 8–10 dm. is often attained in *B. macrophylla*.

The stems are usually subscapose, that is, almost entirely leafless except for a pair of small leaves near the base, as exemplified by a majority of the species of Eubalsamorhiza. The species with leafy or bracteate stems occur in Artorhiza.

Leaves.—The leaves are chiefly opposite, sometimes alternate. Two types of leaf outline are manifest, namely, (1) the ovate to ovate-cordate type, and (2) the oblong-lanceolate pinnate or bipinnatifid type. The name Artorhiza has been assigned to the former group, and Eubalsamorhiza to the latter.

In the section Artorhiza the leaves are either basal or cauline; the cauline alternate types are exemplified in *B. Bolanderi* and *B. invenusta* with ovate or ovate-elliptical outlines. The remaining species, *B. sagittata, B. deltoidea,* and *B. Careyana,* have large, ovate-cordate basal leaves, and bracteate subopposite cauline leaves. The leaf margins in this group are entire, undulate, or dentate with acute apices. The herbaceous texture is common, but in *B. Bolanderi* the leaves become coriaceous and conspicuously reticulated on both surfaces. The subcoriaceous texture is also approached in the more mature leaves of *B. deltoidea* and *B. Careyana,* but the venation never becomes so prominent as in *B. Bolanderi.*

The section Eubalsamorhiza is characterized by a pinnate or bipinnate type of leaf. The pinnate form is the more common; the bipinnate type is characteristic of *B. hirsuta,* and to a less degree of *B. macrolepis.* The subentire leaf is also present in this section. Both pinnate and undivided leaves may occur on the same plant, as in *B. serrata.* In this species the undivided leaves are more common, but in *B. incana* var. *tomentosa* entire or incised leaves are produced. Subentire blades also occur occasionally on the outermost leaves of *B. macrophylla.* The leaves in this section are mostly basal, a pair of small ones being produced on the lower part of the scapose stem.

Pubescence.—The pubescence within the genus is quite diverse—pilose, tomentose, hirsute, velutinous, and sericeous being the common forms. The hairs in a majority of the species

are interspersed by sessile or short-stipitate glands. Frequently the pubescence on the stems is of the pilose nature, interspersed by numerous glands. *Balsamorhiza incana* and its variety *tomentosa* have a covering of long soft tomentum. The usual type of pubescence, however, is the hirsute, hirsute-hispid, or subsericeous.

Inflorescence.—The inflorescence in *Balsamorhiza* consists chiefly of solitary heads which terminate the naked scapose stems. They may be axillary, as in *B. invenusta,* or in raceme-like clusters as in *B. Careyana.* The inflorescence offers no marks of specific importance except in the latter species.

Involucre.—The bracts of the involucre often present important characters for species differentiation, particularly in outline, length with reference to the disk, pubescence, texture, and venation.

The linear-lanceolate to ovate-lanceolate form of involucral bract is the most common. Involucral bracts of this type usually do not exceed the disk in length. An ovate form of bract abruptly constricted above the middle and attenuated to an acute apex is characteristic of *Balsamorhiza hirsuta* and to a less degree of *B. incana.* The bracts of the involucre which exceed the disk in length are foliaceous and mostly oblong or oblong-lanceolate in general outline, as in *B. macrophylla, B. deltoidea,* and *B. macrolepis. Balsamorhiza Bolanderi* is characterized by large, ovate, coriaceous bracts which become glabrate and conspicuously reticulated on both surfaces. The margins of the bracts are entire except in *B. macrolepis* where they are often sparsely serrated or incised.

The pubescence of the involucre is of four sorts, namely, (1) densely tomentose, (2) crisp-pilose, (3) subvelutinous or velvety pubescent, and (4) hirsute or hispid. The densely white-tomentose type of pubescence is exemplified in *B. sagittata* and *B. incana* and its variety *tomentosa. Balsamorhiza serrata* and *B. hirsuta* var. *lagocephala* are the best examples of a dense crisp-pilose-pubescent involucre. A majority of the species, however, are crisp-pilose-ciliate. The velutinous or subsericeous pubescence is characteristic of *B. macrolepis* and

B. Hookeri and its varieties. The hirsute, hispidulus to glabrate condition is also common within the genus.

Receptacle and Pales.—The receptacle in *Balsamorhiza* is broadly convex. The pales are conduplicate and acuminate or acuminate-acute, becoming stiff in the mature heads. They are persistent on the receptacle after the fall of the achenes. Neither the receptacle nor the pales afford any marks that may be used in specific differentiation, but only generic characters.

Corollas.—The heads in *Balsamorhiza* are heterogamous with styliferous and fertile ray-flowers, and usually fertile tubular disk-flowers. *Balsamorhiza invenusta* with eradiate heads, however, is an exception. The corollas in both the ray- and disk-flowers are yellow except in *Balsamorhiza Hookeri* var. *rosea* in which the rays are occasionally purple. The rays are ovate to oblong, subentire, or 2–3-denticulate, styliferous, and accompanied by one or more staminodea. The disk-corollas have a narrow cylindrical tube which expands above into the tubular-campanulate 5-lobed limb.

The stamens are very similar to those described for preceding genera. The style-branches are slender, terete in cross-section, and more or less hirsutulous from base to apex.

Achenes.—The achenes, for the most part, are similar throughout the genus. They are linear-oblong, 5–8 mm. long, and usually glabrous except in *Balsamorhiza Careyana* and *B. Hookeri* var. *rosea* which are pubescent. The disk-achenes are quadrangular, as a rule, with a small rib alternating with each of the four larger angles. *Balsamorhiza invenusta,* however, has rhomboidal disk-achenes and trigonal ray-achenes. The pappus is absent, and only in rare cases in *B. sagittata* has there been observed one or two subulate bristles on each achene.

Geographical Distribution.—The genus *Balsamorhiza* is confined to the northwestern United States. Its center of distribution extends from west-central Wyoming and northern Utah west to southern Washington and northern California. Plants of this genus are mostly inhabitants of dry, usually rocky, open grounds, the deep tap-root system and the low habit enabling them to occupy dry situations.

The subgenus Artorhiza is confined chiefly to the Pacific Coast states, with the exception of *B. sagittata*. This species ranges from the western Dakotas and Colorado west to British Columbia and California, being the most widely distributed species of the genus. *Balsamorhiza deltoidea* is the species with the next widest range, extending from British Columbia southwards to Los Angeles County, California. The remaining species of this section are less widely distributed; for example, *B. Careyana* occurs on dry ground from central and southeastern Washington south to central and northeastern Oregon; while *B. Bolanderi* and *B. invenusta* are confined to central California.

Eubalsamorhiza comprises the greater majority of the species in this genus, but none of the species has a very wide distribution. *Balsamorhiza incana,* having a range from western Wyoming and southwestern Montana west to northeastern Oregon, is the most widely distributed species of the section. *Balsamorhiza macrophylla* and *B. hispidula* occur from western Wyoming and southern Idaho south to Utah and eastern Nevada. The majority of the remaining species are confined to the Pacific Coast region from Washington south to central California.

TAXONOMY

Balsamorhiza [*Balsamorrhiza* of authors] Hook. Fl. Bor.-Am. **1**: 310. [1834] 1840; Nutt. in Trans. Am. Phil. Soc. II. **7**: 349. 1841; Torr. & Gray, Fl. N. Am. **2**: 300. 1842; Walp. Rep. Bot. Syst. **2**: 610. 1843; Benth. & Hook. Gen. Pl. **2**: 366. 1873; Gray, Syn. Fl. N. Am. **1**^{2}: 265. 1884; Hoffm. in Engl. & Prantl. Nat. Pflanzenf. IV. Abt. 5: 234. 1890; Howell, Fl. Northwest Am. **1**: 339. 1900; Coult. & Nels. Bot. Rocky Mts. 545. 1909; Piper & Beattie, Fl. Northwest Coast, 376. 1915; Rydb. Fl. Rocky Mts. 928. 1917; Jepson, Man. Fl. Pl. Cal. 1077. 1925; Blake in Contr. U. S. Nat. Herb. [Tidestrom's Fl. Utah & Nevada] **25**: 582. 1925; Rydb. Fl. Pr. & Pl. Cent. N. Am. 839. 1932.

Roots perennial, fusiform, thick, often becoming very stout in older plants, covered by a rough or corrugated bark. Stems

herbaceous, erect or ascending, leafy, subscapose or scapose, usually unbranched, glabrous or variously pubescent. Leaves opposite or alternate, usually basal, sometimes cauline, ovate-cordate to oblong-lanceolate in general outline, entire, coarsely dentate, incised, pinnately divided to bipinnatifid, acute or acutish, variously pubescent or glabrate. Heads radiate or rarely discoid, usually solitary, sometimes two or more in raceme-like clusters. Bracts of the involucre 2–4-seriate, herbaceous or coriaceous, linear-lanceolate, ovate-lanceolate, ovate-attenuate to oblong, the outer series often foliaceous and longer than the disk, puberulous to densely tomentose. Receptacle broadly convex; pales firm, subcoriaceous, conduplicate, persistent after the fall of the achenes. Disk-flowers light yellow, tube cylindrical, limb tubular to tubular-campanulate, 5-lobed, the base often more strongly developed on one side, glabrous; anther appendages ovate, base sagittate; style-branches slender, attenuate, hirsutulous from base to apex. Rays usually present, fertile, yellow, rarely purplish, oblong-lanceolate, usually 2-denticulate at the apex. Achenes of the disk-flowers fertile, epappose, quadrangulate to subquadrangulate, glabrous or rarely canescent-pubescent, those of the ray-flowers trigonal, otherwise as in the disk-achenes.

Type species: *Balsamorhiza Hookeri* (Hook.) Nutt. in Trans. Am. Phil. Soc. II. **7**: 349. 1841 (*Heliopsis? Balsamorrhiza* Hook. Fl. Bor.-Am. **1**: 310. [1834] 1840).

KEY TO THE SPECIES AND VARIETIES

A. Leaves entire or dentate-serrate, cordate-ovate, deltoid-ovate, ovate or ovate-lanceolate.
  B. Stems leafy to inflorescence; leaves alternate, basal and cauline similar in size.
    C. Heads discoid; bracts of the involucre lanceolate and usually about as long as the disk .... *1. B. invenusta*
    CC. Heads radiate; bracts of the involucre ovate to ovate-lanceolate, foliaceous and much longer than the disk .... *2. B. Bolanderi*
  BB. Stems subscapose, bracteate; leaves opposite, basal leaves large, those of the stem reduced.
    D. Leaves green on both surfaces, scabrous to hirsute, or hispid; involucre green, glabrate, or hirsute to densely crisp-pilose.
      E. Leaves cordate-ovate to deltoid-ovate, entire or coarsely dentate, not conspicuously reticulated.

F. Outer bracts of the involucre lanceolate, seldom exceeding the disk; disk 0.8–2.5 cm. broad; achenes usually cinereous-pubescent . . . . *3. B. Careyana*

FF. Outer bracts of the involucre oblong or oblong-lanceolate, exceeding the disk; disk 2.5–4 cm. broad; achenes glabrous . . . . *4. B. deltoidea*

EE. Leaves lanceolate to ovate-lanceolate, dentate- or serrate-subuliferous, conspicuously reticulated . . . . *11. B. serrata*

DD. Leaves silvery- to white-tomentose beneath; involucre white, persistently woolly tomentose.

G. Leaves cordate-ovate . . . . *5. B. sagittata*

GG. Leaves oblong-ovate to oblong-lanceolate . . . . *9a. B. incana* var. *tomentosa*

AA. Leaves incised, pinnate or bipinnate, lanceolate to oblong-lanceolate in general outline.

H. Leaves canescent or hoary beneath, velutinous, sericeous to tomentose.

I. Leaves velutinous, subsericeous to sericeous.

J. Bracts of the involucre not exceeding the disk, entire.

K. Bracts of the involucre linear-lanceolate, lanceolate to linear-oblong, 2–4 mm. broad, uniformly greenish . . . . *6. B. Hookeri*

KK. Bracts of the involucre triangular-acute to ovate-acute, 5–8 mm. broad, usually brownish or hoary at the apex, greenish below . . . . *7. B. platylepis*

JJ. Bracts of the involucre exceeding the disk, often dentate or incised towards the apex . . . . *8. B. macrolepis*

II. Leaves lanate, floccose-tomentose to tomentose.

L. Leaves lanate; segments narrow, pinnately parted; bracts of the involucre lanceolate . . . . *6b. B. Hookeri* var. *lanata*

LL. Leaves tomentose to floccose-tomentose; segments broadly-lanceolate to ovate-lanceolate, serrate to serrate-incised; bracts of the involucre ovate-attenuate . . . . *9. B. incana*

HH. Leaves green on both surfaces, hispid, hirsute to crisp-pilose.

M. Leaves 3–6 dm. long, crisp-hirsute, crisp-pilose to pilose-tomentose.

N. Leaf-segments 5–11 cm. long, entire, crisp-hirsute; bracts of the involucre longer than the disk; petioles glabrous . . . . *10. B. macrophylla*

NN. Leaf-segments 3–6 cm. long, serrate-dentate or incised, crisp-pilose to pilose-tomentose; bracts of the involucre as long as or shorter than the disk; petioles pilose to pilose-tomentose . . . . *10a. B. macrophylla* var. *idahoensis*

MM. Leaves 0.5–4.5 dm. long, hispid, hispid-pilose to hirsute.

O. Achenes pubescent....*6a. B. Hookeri* var. *rosea*

OO. Achenes glabrous.

P. Leaves hispid to hispid-pilose.

Q. Leaves subcoriaceous, segments serrate-subuliferous; bracts of the involucre subuliferous, pilose-tomentose................................*11. B. serrata*

QQ. Leaves less firm in texture, segments entire, incised or cleft, acute; bracts of the involucre acuminate-acute, hispid-pilose-ciliate.........*12. B. hispidula*

PP. Leaves hirsute to strigose-hirsute.

R. Involucre densely tomentose...............*13a. B. hirsuta* var. *lagocephala*

RR. Involucre not tomentose.

S. Bracts of the involucre ovate, abruptly attenuated into long slender, erect apices....*13. B. hirsuta*

SS. Bracts of the involucre linear-lanceolate to ovate-lanceolate, not attenuated, acute.

T. Leaves cleft or parted, the lobes entire.........*14. B. terebinthacea*

TT. Leaves pinnatifid, the segments usually cleft or incised.............*13b. B. hirsuta* var. *neglecta*

1. **Balsamorhiza invenusta** (Greene) Coville in Contr. U. S. Nat. Herb. **4**: 130. 1893; Jepson, Man. Fl. Pl. Cal. 1077. 1925.

Helianthus invenustus Greene, Pittonia, **1**: 284. 1889.

Stems leafy, erect or ascending, 3–6 dm. tall, pilose-hispid, becoming hispidulous below and densely glandular above; leaves petiolate, ovate, ovate-elliptical to ovate-lanceolate, 1–2 dm. long, 4–9 cm. broad, entire to undulate, acute or acuminate, acutish to subcordate at the base, above scabrous to hispid-hirsute, the midrib often pilose-hispid, beneath glandular, hispid to hirsute-pilose on the veins, the petioles hispid-pilose; heads discoid, solitary, terminal or sometimes axillary, 2.5–4 cm. broad; bracts of the involucre about as long as or longer than the disk, oblong-lanceolate, pilose-hirsute-ciliate, glandular on both surfaces, occasionally sparsely hirsute-hispid along the midvein; disk-corolla about 1 cm. long, the throat tubular, glabrous; mature achenes rhomboidal in cross-section, 7–8 mm.

long, the crown developing knob-like projections at the angles, glabrous.

Distribution: forests of south-central California, Fresno, Tulare, and Kern Counties.

CALIFORNIA: Milwood, Fresno Co., July 23, 1892, *Brandegee* (U CAL); Sequoia Nat. Park, Tulare Co., July, 1908, *Davidson 2058* (U CAL); "giant forest," Tulare Co., July, 1905, *Brandegee* (U CAL); North Fork of Middle Fork of Tule River, eastern Tulare Co., July 11, 1908, *Hall 8340* (U CAL); South Fork of Kaweah River, Tulare Co., July 21, 1904, *Culbertson* (F, G, M, NY, U CAL); mountains of Kern Co., 1888, *Palmer 105* TYPE.

This leafy-stemmed species of *Balsamorhiza* is distinguished by its discoid heads, rhomboidal achenes, and tubular corolla. Its general habit resembles that of *Wyethia ovata* Gray.

2. **Balsamorhiza Bolanderi** Gray in Proc. Am. Acad. **7**: 356. 1868; Syn. Fl. N. Am. 1^2: 266. 1884; Jepson, Man. Fl. Pl. Cal. 1078. 1925.

Stems leafy, erect or ascending, unbranched, 1.5–3 dm. high, glandular above in young specimens, becoming glabrous in older plants; leaves mostly cauline, often bearing large scale-like bracts below, ovate, elliptical to broadly ovate-elliptical, 0.5–2.5 dm. long, 4–10 cm. broad, herbaceous in the early stages, becoming glabrous and leathery, conspicuously reticulated on both surfaces, entire, acute or obtuse-apiculate, cordate to acute at the base, young leaves glandular; heads solitary and terminal, 4–6.5 cm. broad including the rays; bracts of the involucre large, foliaceous, ovate to ovate-lanceolate, 2–3 cm. long, herbaceous, becoming coriaceous and conspicuously reticulated in older plants, tomentose-ciliate in the early stages, later glabrous, acute, glandular to glabrate; rays yellow, about 3 cm. long, glabrous; mature achenes quadrangular, 6–7 mm. long, glabrous.

Distribution: along the mountains, Placer Co., southeast to Mariposa Co., California.

CALIFORNIA: Amador Co., June 12, 1889, *Greene* (NY); "Savage Hill," Amador Co., alt. 2200 ft., May, 1891, *Hansen 168* (M, U CAL); sandy hillsides, Auburn, Placer Co., April, 1865, *Bolander 4526* (G TYPE, NY); Bear Valley, Mariposa Co., May 2, 1892, *Congdon* (U CAL); Bear Valley, Mariposa Co., April 12, 1896, *Congdon* (NY, U CAL); Bear Mountain, Mariposa Co., 1865, *Torrey* (NY); "Proner," *Rich* (NY).

This species may be readily distinguished by its conspicuously reticulated, coriaceous leaves, and large involucral bracts, which also become leathery and prominently reticulated.

3. **Balsamorhiza Careyana** Gray in Mem. Am. Acad. [Pl. Fendl.] N. S. **4**: 81. 1848; Syn. Fl. N. Am. **1**^{2}: 265. 1884; Howell, Fl. Northwest Am. **1**: 339. 1900; Piper in Contr. U. S. Nat. Herb. [Fl. State Wash.] **11**: 580. 1906; Rydb. Fl. Rocky Mts., ed. 2, 929. 1922.

Stems bracteate, one or more arising from the fibrous crowns, 2–6 dm. tall, strigose-hirsute to strigose-hispidulous and glandular above; basal leaves cordate-ovate, cordate-oblong to hastate, 1.5–5 dm. long, 4–13 cm. broad, entire, occasionally coarsely dentate, acute, subcoriaceous, above scabrous, both surfaces green, strigose-hirsute to strigose-hispidulous, and densely to sparsely glandular; cauline leaves opposite, lanceolate to linear-lanceolate, becoming bracteate above; heads radiate, rarely solitary, usually 2 or more in raceme-like or close paniculate clusters, 0.8–2.5 cm. broad excluding the rays; involucre campanulate, the outer series somewhat longer than the inner but rarely longer than the disk, not becoming foliaceous; rays yellow, oblong to oblong-ovate, 2–3 cm. long, bi- or tri-dentate, becoming chartaceous as the head matures; mature achenes linear-oblong, 6 mm. long, ray-achenes 6–7 mm. long, densely canescent-hirsute.

Distribution: dry ground, central and southeastern Washington, south to central and northeastern Oregon.

WASHINGTON: Ellensberg, Kittitas Co., May 20, 1897, *Piper* (NY); Ephrata to Ritzville, Grant Co., June, 1902, *Griffiths & Cotton 483* (NY); Sprague, Lincoln Co., alt. 2000–3000 ft., June, 1893, *Sandberg & Leiberg* (F, G, M, NY, RM, U CAL); dry hillsides, Ritzville, Adams Co., alt. 1451 ft., June 6, 1893, *Sandberg & Leiberg 166* (F, G, M, Ph, NY, U CAL); dry soil, Washtucna, Adams Co., May 18, 1903, *Cotton 976* (G); canyons below Walla Walla, May 23, 1903, *Cotton 1052* (G, M, RM); Walla Walla region, May, 1883, *Brandegee 891* (G, Ph); Prosser, Benton Co., May 27, 1903, *Cotton 1105* (G, M).

OREGON: "Clearwater," *Spalding* (G TYPE, NY, Ph); Pendleton, Umatilla Co., May 15, 1905, *Jones* (NY); near Lexington, Morrow Co., June 5, 1894, *Leiberg 28* (F, G, M, NY, RM); stony, basaltic slope, Bridge Creek, western slope of the Blue Mts., June 22, 1908, *Cusick 3255* (F, G, M, NY, RM, U CAL); hills near Pendleton, Umatilla Co., May–June, 1907, *Cusick 3332* (F, G, M, NY, RM, U CAL); hillsides of "Ochoco River," Crook Co., June 28, 1897, *Cusick 1679* (U CAL); near

"Hoover Creek," Gilliam Co., June 1, 1894, *Leiberg 142* (F, G, M, NY, RM); dry woods, Mt. Hood Forest Reserve, Bear Springs, Wasco Co., July 7, 1929, *Thompson 5171* (Ph).

This species may be distinguished from *B. deltoidea* by the smaller disk and pubescent achenes. The heads are usually in raceme-like clusters, whereas in *B. deltoidea* they are generally solitary. The pubescence of the achene is not always constant. In the region of Wasco and Gilliam Counties, Oregon, where the ranges of the two species overlap, the achenes are invariably glabrous as in *B. deltoidea,* but the other characters are typical *B. Careyana.*

4. **Balsamorhiza deltoidea** Nutt. in Trans. Am. Phil. Soc. II. **7**: 351. 1841; Torr. & Gray, Fl. N. Am. **2**: 302. 1842; Walp. Rep. Syst. **2**: 610. 1843; Gray, Syn. Fl. N. Am. **1**^{2}: 266. 1884; Coville in Contr. U. S. Nat. Herb. **4**: 130. 1893; Howell, Fl. Northwest Am. **1**: 339. 1900; Piper in Contr. U. S. Nat. Herb. [Fl. State Wash.] **11**: 580. 1906; Piper & Beattie, Fl. Northwest Coast, 376. 1915; Rydb. Fl. Rocky Mts., ed. 2, 928. 1922; Jepson, Man. Fl. Pl. Cal. 1078. 1925.

Balsamorhiza glabrescens Benth. Pl. Hartw. 317. 1849.

Stems bracteate, 2–8 dm. tall, crisp-pilose to crisp-hirsute, glandular above, glabrate; basal leaves numerous with petioles 1–4 cm. long, the blades cordate-ovate, cordate-oblong to hastate, 0.8–3 dm. long, 0.4–2 dm. broad, entire or occasionally coarsely dentate, becoming subcoriaceous in late stages, acute, both surfaces green, crisp-hirsute to more or less strigose-hirsute, usually glandular, becoming scabrous above; cauline leaves reduced, becoming bracteate above, lanceolate to linear-lanceolate, 3–15 cm. long, 1–3 cm. broad, entire, acute, surface as in the basal leaves, the lowermost pair usually opposite; heads solitary or sometimes two or more, 2.5–4 cm. broad excluding the rays; involucre hemispherical to subhemispherical, bracts oblong-lanceolate to oblong, the outer series foliaceous, longer than the disk, often 3–6 cm. long in later stages, acute or obtuse, the base of the outer bracts often densely crisp-pilose; rays yellow, oblong-lanceolate, 2–4.5 cm. long; mature achenes about 8 mm. long, linear-oblong, glabrous.

Distribution: dry open ground, British Columbia southwards along the Coast Ranges to Los Angeles Co., California.

British Columbia: Vancouver Island, May 10, 1875, *Macoun 953* (G); Vancouver Island, 1858, *Lyall* (G); vicinity of Victoria, Vancouver Island, May 10, 1893, *Macoun 475* (M, NY); Lake Osoyoos, June 3, 1905, *Macoun 76941* (F); Vancouver Island, May 5, 1908, *Macoun 86299* (F); near "Lost Lake," Victoria, May 23, 1916, *Newcombe 62* (G); "Thetis Lake," Vancouver Island, open wooded hillsides, June 13, 1919, *Carter* (G).

Washington: Whidbey Island, Clallam Co., *Gardner* (U CAL); Tacoma, Pierce Co., May 20, 1911, *Zeller* (M); Lake View, Pierce Co., May, 1928, *Grant* (RM); Ellensberg, Kittitas Co., June, 1897, *Piper* (RM); Vancouver, Clarke Co., June 8, 1904, *Piper 4945* (G); Klickitat River, near "Mt. Paddo," May 18, 1884, *Suksdorf 364* (G); near Bingen, Klickitat Co., May 5, 1909, *Suksdorf* (NY); Yakima region, 1882, *Brandegee* (M); common on dry grounds, Klickitat Co., April 3, June, 1883, *Suksdorf* (F, Ph); slopes of "Mt. Stuart," July 24, 1893, *Sandberg & Leiberg 573* (G, NY); Painted Rocks, Yakima Co., May 20, 1923, *Nelson 1476* (RM); Tacoma, Pierce Co., May 20, 1911, *Brandell* (M); Rattlesnake Hills, Yakima Co., May 2, 1901, *Cotton 336* (Ph); Lake Chelan, Cascade Mts., Chelan Co., July 1–Sept. 15, 1915, *Kammerer 60* (M); dry prairies near Ft. Lewis, Pierce Co., April 26, 1930, *Thompson 5133* (M).

Oregon: "near the outlet of the Wahlamet," May, 1835, *Nuttall* (G, NY, Ph type); near Philmath, Benton Co., May 31, 1919, *Holmes* (M); Forest Grove, Washington Co., May, 1884, *Drake & Dickson* (F); hillsides near Dalles, Wasco Co., April 19, 1903, *Lunell 67* (G); hillsides and prairies, Hood River Co., April 26, 1924, *Henderson 362* (M); hillsides, Deer Creek, near Selma, Josephine Co., April 11, 1926, *Henderson 5702* (M, RM); west shore of Summer Lake, Lake Co., June 3, 1911, *Eggleston 6820* (NY); high ground, Monmouth, Polk Co., May 20, 1893, *Page 216* (F); hillsides, Scoggin's Village, Washington Co., May 20, 1896, *Lloyd* (NY); dry ridge, 4 mi. west of Table Rock, Clackamas Co., May 30, 1924, *Peck* (WU); dry slope, Ashland, Jackson Co., July 14, 1913, *Peck* (WU); dry hillsides, the Dalles, Wasco Co., April 7, 1914, *Peck 5040* (WU); Wimer, Jackson Co., June 29, 1892, *Hammond 209* (M, NY, Ph, RM); Salem, Marion Co., 1871, *Hall 276* (F, G, M); dry ground near Hood River, Hood River Co., April 3, 1926, *Thompson 661* (M); "Scraggins" Valley, Washington Co., May 21, 1927, *Thompson 2495* (Ph); open pastures near Estacada, Clackamas Co., June 11, 1927, *Thompson 2593* (Ph); hills near Brownsboro, Jackson Co., April 10, 1927, *Thompson 2163* (Ph); open sandy hillsides, Hood River, Hood River Co., May 10, 1920, *Gorman* (Ph); hill, one mile east of Mosier, Wasco Co., May 5, 1928, *Gale 111* (M, Ph); open ground, Salem, Marion Co., May 2, 1917, *Nelson 1091* (G); border of field, 3 miles south of Salem, Marion Co., April 23, 1921, *Nelson 3506* (Ph); dry open woods, Grants Pass, Josephine Co., April 20, 1912, *Prescott 11* (G); Dalles, Wasco Co., April, 1882, *Howell* (NY); June, 1881, *Howell* (F, G, Ph).

California: Kernville, Kern Co., May 14, 1892, *Brandegee* (U CAL); between Auburn and Coal, Eldorado Co., April 28, 1909, *Brandegee* (U CAL); Water Canyon, Tehachapi Mts., Kern Co., alt. 6000 ft., June 26, 1908, *Abrams & McGregor 833* (NY); Liebre Mts., Los Angeles Co., alt. 4500 ft., June 20–23, 1908, *Abrams & McGregor 356* (G, NY); Cantara, Siskiyou Co., May 23, 1923, *Eastwood 11927* (M); Tehachapi, Kern Co., May 13, 1913, *Eastwood 3237* (G, NY); near Inde-

pendence, Inyo Co., alt. 5500 ft., *Hall & Chandler 7304* (M, U CAL); south slope near Kernville, Kern Co., alt. 5000 ft., June 1904, *Hall & Babcock 5100* (U CAL); Tejon Pass, Los Angeles Co., June, 1905, *Hall 6263* (U CAL); in grassy spots among pines, Sierra Nevada foothills, Eldorado Co., April 13, 1921, *Hall 11246* (U CAL); hillsides beneath pines, Yosemite Nat. Park, Mariposa Co., June 10, 1911, *Hall 8907* (U CAL); on Moro Creek, San Rafael Mts., Santa Barbara Co., May 18, 1907, *Hall 7797* (Ph, RM, U CAL); Blue Cañon, Placer Co., alt. 4701 ft., June 24, 1908, *Walker 1285* (U CAL); Mendocino Co., 1866, *Bolander 6187* (F, G, M, NY); dry open stony slopes, Back Mt., Humboldt Co., *Tracy 4175* (U CAL); Burnt Ranch, Trinity Co., alt. 1500 ft., April 27, 1924, *Tracy 6662* (U CAL); open woods, Trinity River Valley, Humboldt Co., alt. 600 ft., May 17, 1925, *Tracy 6984* (U CAL); Tehachapi Valley, Kern Co., May 11, 1896, *Davy 2185* (U CAL); open ground, ''Rawhide Hill,'' Tuolumne Co., May 30, 1919, *Williamson 185* (NY); Keene Station, Kern Co., May 1, 1905, *Heller 7802* (G, M, NY, Ph); on the New-ville-Cuelo Road, Glenn Co., alt. 3000 ft., June 16, 1915, *Heller 11977* (M); dry soil, Siskiyou Co., April 14, 1909, *Butler 595* (U CAL); Klamath Hills, Siskiyou Co., April 16, 1910, *Butler 1180* (M, RM, U CAL); near Yreka, Siskiyou Co., April 25, 1876, *Greene 718* (F, G, M, NY); region of Tehachapi Peak, Kern Co., June 25, 1895, *Dudley 363* (F, NY, U CAL); Sonoma Co., coll. of 1853–54, *Bigelow* (G, NY); open hills near ''French Flat,'' Tuolumne Co., alt. 1450 ft., April 11–16, 1919, *Ferris 1580* (NY); ''Mt. Sanhedrin,'' Mendocino Co., June 7, 1893, *Blankinship* (G).

The leaves of *B. deltoidea* are of relatively thin texture in the early stages, but after the flowering season they become more or less coriaceous. This occurrence is more common in the southern part of its range.

5. **Balsamorhiza sagittata** (Pursh) Nutt. in Trans. Am. Phil. Soc. II. **7**: 350. 1841; Torr. & Gray, Fl. N. Am. **2**: 301. 1842; Walp. Rep. Bot. Syst. **2**: 610. 1843; Gray in Mem. Am. Acad. [Pl. Fendl.] N. S. **4**: 82. 1848; Syn. Fl. N. Am. **1**^{2}: 265. 1884; Howell, Fl. Northwest Am. **1**: 339. 1900; Piper in Contr. U. S. Nat. Herb. [Fl. State Wash.] **11**: 580. 1906; Coult. & Nels. Bot. Rocky Mts. 545. 1909; Rydb. Fl. Rocky Mts., ed. 2, 928. 1922; Blake in Contr. U. S. Nat. Herb. [Tidestrom's Fl. Utah & Nevada] **25**: 582. 1925; Jepson, Man. Fl. Pl. Cal. 1078. 1925; Rydb. Fl. Pr. & Pl. Cent. N. Am. 839. 1932.

Buphthalmum sagittatum Pursh, Fl. Am. Sept. **2**: 564. 1814.

Balsamorhiza helianthoides Nutt. in Trans. Am. Phil. Soc. II. **7**: 351. 1841; Torr. & Gray, Fl. N. Am. **2**: 302. 1842; Walp. Rep. Bot. Syst. **2**: 610. 1843.

Espeletia helianthoides Nutt. in Jour. Acad. Nat. Sci. Phila. **7**: 39. 1834.

Espeletia sagittata Nutt. *Ibid.* 38. *pl.* 4. 1834.

Stems leafless or bracteate, one to several from a single crown, 2–6.5 dm. tall, tomentose below, densely tomentose above; leaves basal, cordate-ovate, cordate-oblong to hastate, 2–4 dm. long, 0.5–1.5 dm. broad, entire, acute, above cinereous-strigulose, beneath silvery tomentulose to velutinous; heads usually solitary, sometimes 2–3, 6–11 cm. broad including the rays; bracts of the involucre ovate-lanceolate to lanceolate, the outer series longer than the inner, acuminate to attenuate, densely white-tomentose; pales long-attenuate, terminating in an awl-like apex, pilose-ciliate; rays yellow, oblong-lanceolate, 2–4 cm. long, 0.8–1.5 cm. broad, tube crisp-pilose; mature achenes linear-oblong, 7–8 mm. long, glabrous.

Distribution: dry ground, South Dakota and Colorado, west to British Columbia and California.

SOUTH DAKOTA: limestone, Black Hills Nat. Forest, June 15, 1910, *Murdock 4096* (F, G); limestone, west of Custer, Custer Co., alt. 6000–6500 ft., July 29, 1892, *Rydberg 808* (G, NY).

MONTANA: hills near Midvale, Teton Co., June 16, 1903, *Umbach 60* (F); near Great Falls, Cascade Co., May 2, 1886, *Anderson* (U CAL, M); near Butte, Silver-bow Co., 1893, *Moore* (M); Bridger Mts., Gallatin Co., June 11, 1897, *Rydberg & Bessey 5174* (F, G, NY, RM); Custer, Yellowstone Co., May 30, 1890, *Blankinship 52* (G, M); near Missoula, Missoula Co., May 19, 1924, *Kirkwood 1732* (RM, U CAL); Helena, Lewis and Clark Co., June 24, 1888, *Kelsey* (U CAL); Flathead region, Flathead Co., 1883, *Ayres 63* (Ph); Flathead River, 1834, *Nuttall* (Ph TYPE).

WYOMING: Laramie Hills, Albany Co., June, 1908, *Nelson 9140* (RM); Evanston, Uinta Co., June 4, 1898, *Nelson 4518* (RM); hills, Bush Ranch, Sweetwater Co., June 10, 1900, *Nelson 7084* (RM); dry soil, Leucite Hills, Sweetwater Co., June 18, 1901, *Merrill & Wilcox 686* (G, RM); Glen Creek, Yellowstone National Park, July 1, 1899, *Nelson & Nelson 5613* (G, M, NY, RM); Little Goose Canyon, Sheridan Co., June 22, 1913, *Sharp 356* (RM); Fremont Lake, Fremont Co., June 29, 1904, *Warren* (RM); near Rawlins, Carbon Co., June 30, 1899, *Pammel 75* (M); dry rocky flats, Grand Teton National Park, June 17, 1933, *Williams 1125* (M); dry open ground, near the "Devil's Tower," Crook Co., June 27, 1929, *Palmer* (G).

COLORADO: Cimarron, Montrose Co., alt. 7000 ft., May 19, 1898, *Crandall 2723* (F, G, NY, Ph, RM); Rio La Plata, La Plata Co., June, 1875, *Brandegee 1077* (U CAL); Mesa Verde National Park, May 27, 1925, *Schmoll & Nusbaum 1574* (RM); Cerro Summit, Montrose Co., alt. 8000 ft., June 7, 1901, *Baker 51* (G, M, NY, RM, U CAL); Norwood Hill, San Miguel Co., Aug. 16, 1912, *Walker 466* (G, M, RM); open meadows, near Naturita, Montrose Co., alt. 7000 ft., May 25, 1914, *Payson 343* (F, G, M, RM).

UTAH: Ogden, Weber Co., July 1, 1880, *Engelmann* (M); hillsides, Wheelon-

Collinston, Boxelder Co., May 1, 1911, *Smith 2348* (NY); Fort Douglas, Salt Lake Co., May 5, 1908, *Clemens* (F, G, Ph); dry hillsides, Daggett Co., May 28, 1932, *Williams 415* (NY, RM).

IDAHO: Kootenai Co., July, 1890, *Leiberg* (F, NY); Boise, Ada Co., alt. 2880 ft., May 27, 1911, *Clark 28* (F, G, M, RM, U CAL); Montpelier, Bear Lake Co., May 20, 1910, *Macbride 202* (G, M, RM); near Lewiston, Nez Perces Co., April 27, 1896, *Heller & Heller 2958* (F, M, NY, Ph); New Plymouth, Canyon Co., alt. 2200 ft., May 21, 1910, *Macbride 79* (G, M, NY, RM).

NEVADA: Pyramid Lake, Washoe Co., June 1, 1913, *Kennedy 1985* (M, Ph, U CAL); King's Cañon, Ormsby Co., June 1, 1902, *Baker 926* (G, M, NY, RM, U CAL); Carson City, 1863, *Anderson 173* (G).

BRITISH COLUMBIA: between Midway and Lake Osoyoos, May 5, 1905, *Macoun 76942* (NY); Spencer's Bridge, May 26, 1889, *Macoun* (G).

WASHINGTON: Pullman, Whitman Co., June 1, 1893, *Piper 1594* (F, G, NY); Hangman Creek, Spokane Co., alt. 1510 ft., May 17, 1893, *Sandberg & Leiberg 23* (F, G, M, NY, Ph, RM, U CAL); rocky slopes, north of Entiat, Chelan Co., April 18, 1931, *Thompson 5985* (G, NY); open slopes, Beverly Creek, Kittitas Co., May 16, 1931, *Thompson 6386* (G); hillsides near Waitsburg, Walla Walla Co., April 21, 1897, *Horner B277* (G); among sage-brush near Coulee City, Grant Co., May 2, 1931, *Thompson 6126* (G).

OREGON: near North Powder, Union Co., May 10, 1928, *Gale 255* (Ph); Wallowa Co., April 30, 1927, *Gabrielson* (Ph); near Lone Rock, Lillian Co., alt. 890 m., May 25, 1894, *Leiberg 114* (F, NY, U CAL); 15 mi. n. e. of Pendleton, Umatilla Co., May 17, 1923, *Sherwood 372* (F, WU); dry ground, Harney Co., June 28, 1912, *Peck 3071* (WU); sagebrush, Brogan, Malheur Co., 1910, *Cooper 1182* (WU); Dog Mt., Lake Co., July 8, 1927, *Peck 15544* (M).

CALIFORNIA: Alpine Co., June, 1892, *Hansen 420* (M); American Valley, Plumas Co., June, 1875, *Austin 94* (U CAL); on Sierra Nevada, above Jonesville, Butte Co., alt. 7000 ft., June 16, 1915, *Heller 12026* (F, G, M); open places in the yellow-pine forest at Mineral, Tehama Co., May 30, 1928, *Heller 14594* (M, NY); Goose Lake Valley, Modoc Co., May, 1894, *Austin 47* (U CAL); Deer Park, Placer Co., alt. 6500 ft., *Walker 2016* (M, RM).

6. Balsamorhiza Hookeri Nutt. in Trans. Am. Phil. Soc. II, **7**: 349. 1841; Torr. & Gray, Fl. N. Am. **2**: 301. 1842; Walp. Rep. Bot. Syst. **2**: 610. 1843; Gray, Syn. Fl. N. Am. **1**^{2}: 266. 1884; Howell, Fl. Northwest Am. **1**: 340. 1900; Coult. & Nels. Bot. Rocky Mts. 546. 1909; Blake in Contr. U. S. Nat. Herb. [Tidestrom's Fl. Utah & Nevada] **25**: 583. 1925, in part; Jepson, Man. Fl. Pl. Cal. 1078. 1925, in part.

Heliopsis (?) *Balsamorrhiza* Hook. Fl. Bor.-Am. **1**: 310. [1834] 1840; DC. Prodr. **5**: 551. 1836.

Balsamorrhiza Balsamorrhiza (Hook.) Heller in Cat. N. Am. Pl. 7. 1898; Piper in Contr. U. S. Nat. Herb. [Fl. State Wash.] **11**: 581. 1906; Piper & Beattie, Fl. Northwest Coast, 376. 1915.

Stems scapose, 1–3 dm. tall, pilose near the heads, otherwise subsericeous; leaves ovate-lanceolate to lanceolate, pinnately incised or divided, 1–3 dm. long, the divisions cleft into several spreading or ascending, acute or entire lobes, 1–4 cm. long, 0.5–1 cm. broad, subvelutinous-canescent on both surfaces, often densely so on the younger leaves, of medium texture; heads solitary, 4–7 cm. broad including the rays; bracts of the involucre linear-lanceolate to linear-oblong, about as long as or shorter than the disk, acute, pilose; rays yellow, oblong to ovate-oblong, 1.5–2.5 cm. long, bifid or entire, tube and lamina pubescent; achenes 4–5 mm. long, glabrous.

Distribution: moist grounds, Yakima and Klickitat Counties, west to Clark County, Washington.

WASHINGTON: near the mouth of the Columbia River, "1834–35," *Nuttall* (G, Ph, NY); Tampico, Yakima Co., April 6, 1924, *Nelson 1595* (RM); Simcoe Mts., Yakima Co., June, 1881, *Howell* (NY); prairies, Simcoe Mts., Yakima Co., *Howell* (G); low grounds, Falcon Valley, Klickitat Co., May 20, 1881, *Suksdorf* (F, Ph); low grounds in open woods, Falcon Valley, Klickitat Co., May 3, 1884, *Suksdorf 357* (G); Klickitat River, Klickitat Co., May 18, 1884, *Suksdorf 359* (G); Falcon Valley, Klickitat Co., May 3, 1884, *Suksdorf 363* (G); Mill Plain, Clark Co., June 4, 1880, *Howell* (F).

6a. var. **rosea** (Nels. & Macbr.) W. M. Sharp, comb. nov.

Balsamorhiza rosea Nels. & Macbr. in Bot. Gaz. **56**: 478. 1913.

Stems about 1 dm. tall, purplish; leaves .8–1.2 dm. long, strigose-hirsutulous; rays yellow or purplish; achenes 5–6 mm. long, pubescent; in all other characters similar to the species.

Distribution: thin rocky ridges of Rattlesnake Mts., Yakima Co., Washington.

WASHINGTON: ridges of Rattlesnake Mts., Yakima Co., May 8, 1902, *Cotton 568* (G, M, Ph, RM TYPE).

6b. var. **lanata** W. M. Sharp, var. nov.[10]

Leaves 1–2.5 dm. long, bipinnately divided, the segments narrow, 1.5–5 cm. long, 0.5–1 cm. broad, lanceolate, acute, lanate

[10] **B. Hookeri** var. **lanata** W. M. Sharp, var. nov., foliis 1–2.5 dm. longis, pinnatisectis, segmentis angustis, 1.5–5 cm. longis, 0.5–1 cm. latis, lanceolatis, acutis, utrinque lanatis; petiolis dense lanatis; bracteis involucri lanceolatis, acuminatis, lanatis. Cetera speciei similis.—Collected near Yreka, Siskiyou Co., California, May 2, 1876, *Greene 745* (F, G, M TYPE).

on both surfaces; petioles densely lanate; bracts of the involucre lanceolate, acuminate, lanate; other characters similar to the species.

Distribution: dry hills near Yreka, Siskiyou Co., California.

CALIFORNIA: near Yreka, Siskiyou Co., May 2, 1876, *Greene 745* (F, G, M TYPE); dry hills near Yreka, Siskiyou Co., April 9, 1910, *Butler 1157* (M, RM, U CAL); near Yreka, Siskiyou Co., April, 1903, *Mooney* (U CAL).

7. **Balsamorhiza platylepis** W. M. Sharp, sp. nov.[11]

Stems scapose, 1–3.5 dm. high, with cinereous-appressed pubescence; leaves pinnately divided, 1–3 dm. long, the divisions 2–5 cm. long, 0.5–1.5 cm. broad, entire, coarsely serrate to incised, acute, above light green, velutinous to subsericeous, beneath silvery sericeous to velutinous; heads solitary, 4–6 cm. broad including the rays; bracts of the involucre equalling or shorter than the disk, triangular to ovate, acute, 1–2 cm. long, 5–8 mm. broad, outer series brownish or hoary at the apex, greenish below, sericeous to velutinous; rays yellow, broadly oblong, 2–3.5 cm. long, .5–1 cm. broad, bifid or entire, tube and lamina pubescent; achenes 6–8 mm. long, glabrous, epappose.

Distribution: dry gravelly or rocky ground, southern Oregon, southward to west-central Nevada and northern California.

NEVADA: Marmol Station, Washoe Co., alt. 5000 ft., May 30, 1912, *Kennedy 1859* (F TYPE, G, M, NY); near Verdi, Washoe Co., May 5, 1895, *Sonne* (NY).

OREGON: serpentine ridge northwest of Selma, Josephine Co., April 13, 1924, *Thompson 2272* (WU); hillsides near Waldo, Josephine Co., April, 1887, *Howell* (M, NY); serpentine hills along Deer Creek, north of Selma, Josephine Co., March 29, 1926, *Henderson 5703* (RM); "Quartz Valley," 1893, *Austin* (U CAL).

CALIFORNIA: Modoc Co., July, 1898, *Austin & Bruce 2179* (NY, U CAL); Goose Lake Valley, Modoc Co., May, 1894, *Austin* (U CAL, Ph); lava beds near Egg Lake, Modoc Co., June 8, 1894, *Baker & Nutting* (RM, U CAL); Goose Valley, Shasta Co., June–July, 1912, *Eastwood 896* (G, NY); Plumas Co., 1879, *Austin*

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[11] **B. platylepis** W. M. Sharp, sp. nov., caulibus scaposis, 1–3.5 dm. altis, adpresso-cinereo-pubescentibus; foliis pinnatisectis, 1–3 dm. longis, segmentis 2–5 cm. longis, 0.5–1.5 cm. latis, integris, grosse serratis vel incisis, acutis, supra pallide viridibus, plus minusve velutinis vel subsericeis, subtus argenteo-sericeis vel velutinis; bracteis involucri disco aequalibus vel brevioribus, triangulatis vel ovatis, acutis, 1–2 cm. longis, 5–8 mm. latis, exterioribus ad apicem fulvis aut albidis, subtus viridibus, sericeis vel velutinis.—Collected at Marmol Station, Washoe Co., Nevada, alt. 5000 ft., *Kennedy 1859* (F TYPE, G, M, NY).

(G); near Truckee, Nevada Co., June 7, 1917, *Hall 10327* (U CAL); Dog Valley, Sierra Co., May, 1892, *Sonne 368* (M); Hobart Mills, Nevada Co., May–June, 1925, *Drew* (RM).

8. **Balsamorhiza macrolepis** W. M. Sharp, sp. nov.[12]

Stems usually scapose, 2–6 dm. high, below appressed-pilose, above appressed or spreading pubescent; leaves pinnately divided to bipinnatifid, 2.5–5 dm. long, the divisions lanceolate in general outline, 3–10 cm. long, 0.5–2 cm. broad, entire, incisely toothed or again pinnatifid, acute, above green, subvelutinous, beneath light green to canescent, densely subsericeous to velutinous, glandular; heads solitary, radiate, 4–8 cm. broad including the rays; bracts of the involucre 3-seriate, the outer series large, twice as long as the disk, oblong to oblong-lanceolate, 2–3.5 cm. long, 0.5–1.3 cm. broad, obtuse or abruptly acuminate, often dentate or incised towards the apex, minutely velutinous; rays yellow, oblong-elliptical, 2.5–3 cm. long, 1–1.5 cm. broad, tube and lamina puberulent to glabrous; achenes linear-oblong, 5–7 mm. long, quadrangular, glabrous.

Distribution: north-central California, Butte Co., southeast to Mariposa Co., southwest to Sonoma and Santa Clara Counties.

CALIFORNIA: Clear Creek, Butte Co., May 1–15, 1897, *Brown 208* (F, M, NY TYPE, Ph, RM); Brush Creek, Butte Co., 1908, *Konger 122843* (U CAL); fields, Butte Co., May 1898, *Bruce 2469* (NY); sandy hillsides near Lincoln, Placer Co., April 15, 1917, *Ramaley 11109* (U CAL); Amador, Amador Co., alt. 1000 ft., May, 1895, *Hansen 1069* (M); Sonoma, Sonoma Co., 1853–54, *Bigelow* (G, NY); Cedar Mt., Alameda Co., May, 1903, *Elmer 4374* (M, NY, U CAL); Oakland Hills, near Oakland, Alameda Co., June 6, 1868, *Kellogg & Harford 430* (NY, G); San Martin, Santa Clara Co., March 30, 1901, *Chandler 914* (U CAL); Bear Mt., Mariposa Co., 1865, *Torrey* (M); ''Coulterville Road,'' Yosemite Nat. Park, Mariposa Co., alt. 4500 ft., June 7, 1911, *Hall 8885* (U CAL); ''Kirby Ranch,'' Mariposa Co., May, 1886, *Congdon* (U CAL).

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[12] **B. macrolepis** W. M. Sharp, sp. nov., caulibus 2–6 dm. altis, infra adpresse pilosis, supra adpresse vel laxe pubescentibus; foliis pinnatiscissis vel bipinnatifidis, 2.5–5 dm. longis, segmentis lanceolatis, 3–10 cm. longis, 0.5–2 cm. latis, integris, incisis aut pinnatifidis, acutis, supra viridibus et subvelutinis, subtus pallide viridibus vel canescentibus et plus minusve dense subsericeis vel velutinis, glandulosis; bracteis involucri 3-seriatis, exterioribus magnis, disco duplo longioribus, oblongis vel oblongo-lanceolatis, 2–3.5 cm. longis 0.5–1.3 cm. latis, obtusis aut acuminatis, saepe ad apicem dentatis vel incisis, minute velutinis.—Collected at Clear Creek, Butte Co., California, May 1–15, 1897, *Brown 208* (F, M, NY TYPE, Ph, RM).

This species may be readily distinguished from other species of *Balsamorhiza* by its large puberulous, oblong bracts 2–3 cm. long, large leaves 2.5–5 dm. long, and its soft subvelutinous pubescence. This is the only pinnate-leaved species of this genus occurring in California south of Butte County.

9. **Balsamorhiza incana** Nutt. in Trans. Am. Phil. Soc. II. **7**: 350. 1841; Torr. & Gray, Fl. N. Am. **2**: 301. 1842; Walp. Rep. Bot. Syst. **2**: 610. 1843; Howell, Fl. Northwest Am. **1**: 340. 1900; Coult. & Nels. Bot. Rocky Mts. 546. 1909; Rydb. Fl. Rocky Mts., ed. 2, 929. 1922; Blake in Contr. U. S. Nat. Herb. [Tidestrom's Fl. Utah & Nevada] **25**: 582. 1925.

Balsamorrhiza Hookeri var. *incana* (Nutt.) Gray, Syn. Fl. N. Am. 1^2: 266. 1884.

Balsamorrhiza floccosa Rydb. in Bull. Torr. Bot. Club **27**: 629. 1900; and Fl. Rocky Mts., ed. 2, 929. 1922.

Stems subscapose, 1.5–4 dm. tall, white-tomentose to lanate-tomentose; leaves lanceolate to oblong-lanceolate, pinnately divided, 1–4 dm. long, the divisions lanceolate, oblong-lanceolate to ovate-lanceolate, 1.5–6 cm. long, 0.5–2.5 cm. broad, entire, coarsely serrate or serrate-incised, acute, above light green, beneath cinereous, both surfaces tomentose to floccose-tomentose, petioles tomentose to lanate-tomentose; heads solitary, 7–11 cm. broad including the rays; bracts of the involucre 3-seriate, ovate-attenuate to lance-attenuate, about as long as the disk, densely white-tomentose to floccose-tomentose; pales attenuate-subulate, pilose on the upper half; rays yellow, oblong, 3–4.5 cm. long, 0.5–1 cm. broad, bifid or entire, tube and base of lamina pilose-tomentose; disk-flowers 9–10 mm. long, glabrous; achenes linear-oblong, 5–6 mm. long, glabrous.

Distribution: southwestern Montana and western Wyoming to Washington and Oregon.

MONTANA: Spanish Basin, Gallatin Co., alt. 6000 ft., July 1, 1897, *Rydberg & Bessey 5175* (F, G, NY, RM); "Camp Creek," June 12, 1905, *Jones* (U CAL).

WYOMING: Rocky Mountains, 1834, *Nuttall* (Ph TYPE); Three Forks of the Missouri and Yellowstone Rivers, June 30, 1860, *Hayden* (M); dry soil, "Big Sandy River near Leckie," June 22, 1901, *Merrill & Wilcox 743* (G, RM, NY); eastern slope of the Big Horn Mts., headwaters of Clear Creek, Johnson Co., alt. 7000–9000 ft., July 20–Aug. 15, 1900, *Tweedy 3150* (RM, NY); Rattlesnake Mts.,

Natrona Co., July 29, 1898, *Nelson 4993* (M, RM, NY); near Big Horn, Sheridan Co., alt. 5000 ft., July 2, 1897, *Pammel & Stanton 322* (M); Little Goose Cr., Sheridan Co., July 16, 1896, *Nelson 2342* (RM, M); headwaters of the Tongue River, Big Horn Mts., Sheridan Co., July, 1898, *Tweedy 11* (NY); Wind River Range, June, 1873, *Parry 165* (M, Ph, NY); Little Bald Mt., Big Horn Mts., Bighorn Co., alt. 9500 ft., July 13, 1900, *Jack* (G); Wind River Valley, May 18, 1860, *Hayden* (M); Big Horn Mts., Sheridan Co., alt. 7500 ft., July, 1899, *Tweedy 2115* (NY).

Idaho: about Lake Waha, Nez Perces Co., alt. 3500–4000 ft., June 22, 1896, *Heller & Heller 3298* (M, Ph, NY, U CAL); Clearwater, *Spalding* (G, Ph); Craig Mts. at Lake Waha, Nez Perces Co., May 24, 1892, *Sandberg, MacDougal & Heller 248* in part (F, G, NY).

Washington: open slopes near Lindel, Asotin Co., May 20, 1928, *St. John & Brown 3900* (Ph); Blue Mts., Columbia Co., June 11, 1887, *Horner* (G).

Oregon: Cabbage Hill east of Pendleton, Umatilla Co., May 10, 1928, *Gale 178* (M); dry open ground near Pendleton, Umatilla Co., June 24, 1927, *Gabrielson* (Ph, WU); 3 miles south of Elgin, Union Co., May 22, 1923, *Sherwood 323* (WU, F); "Camas prairie," July, 1902, *Griffiths & Hunter 77* (NY).

9a. var. **tomentosa** (Rydb.) W. M. Sharp, comb. nov.

Balsamorrhiza tomentosa Rydb. in Bull. Torr. Bot. Club. **27**: 628. 1900; Fl. Rocky Mts., ed. 2, 928. 1922.

Leaves oblong-ovate to oblong-lanceolate, 2.5–4 dm. long, 3–8 cm. broad, subentire, dentate-lacerate to incised, acute, above light green, tomentose to lanate-tomentose, beneath whitish, densely tomentose; bracts of the involucre linear-lanceolate, abruptly attenuate, densely tomentose; otherwise similar to the species.

Distribution: western Montana, Wyoming, and Idaho.

Montana: hills, "Snowshoe Gulch," July 12, 1883, *Canby 189* (Ph).

Wyoming: eastern slopes of the Big Horn Mts., headwaters of Clear Creek, Johnson Co., alt. 7000–9000 ft., July 20–Aug. 15, *Tweedy 3151* (NY, RM); headwaters of the Tongue River, Big Horn Mts., July, 1898, *Tweedy 10* (NY type); Big Horn Mts., Sheridan Co., alt. 7500 ft., July, 1899, *Tweedy 214* (NY).

Idaho: hillsides, Craig Mt. at Lake Waha, Nez Perces Co., May 24, 1892, *Sandberg, MacDougal & Heller 248* (M).

The subentire to incised leaf-blades, the tomentose-pubescent leaves, and the linear-lanceolate, strongly attenuated and acute bracts are the main distinguishing characters of this variety.

10. Balsamorhiza macrophylla Nutt. in Trans. Am. Phil. Soc. II, **7**: 350. 1841; Torr. & Gray, Fl. N. Am. **2**: 301. 1842; Walp. Rep. Bot. Syst. **2**: 610. 1843; Gray, Syn. Fl. N. Am. 1^2: 266.

1884; Rydb. Fl. Rocky Mts., ed. 2, 929. 1922; Blake in Contr. U. S. Nat. Herb. [Tidestrom's Fl. Utah & Nevada] **25**: 583. 1925.

Balsamorhiza macrophylla var. *terebinthacea* Nels. in Coult. & Nels. Bot. Rocky Mts., 546. 1909, not *B. terebinthacea* (Hook.) Nutt.

Stems subscapose, 3–10 dm. high, crisp-pilose and glandular to glabrate; leaves pinnate or pinnately cleft, rarely subentire, 3–6 dm. long, 6–16 cm. broad, hirsute-ciliate on the margins, above green and sparsely crisp-hirsute to glabrous, beneath green, glandular, and crisp-hirsute on the veins, segments 5–11 cm. long, entire or sparsely toothed; petioles glandular, glabrous to sparingly pubescent; heads solitary, including the rays 8–12 cm. broad; bracts of the involucre lanceolate, oblong-lanceolate, 2.5–5 cm. long, acute to acuminate, densely pilose to hirsute-pilose-ciliate, dorsal surface sparsely pilose-hirsute; rays broadly oblong-elliptical, 3.5–5.5 cm. long, 1.5–2.2 cm. broad, bifid or entire, tube and outer surface of lamina puberulent or glabrous; achenes linear-oblong, quadrangular, with a small rib between each of the larger angles, 8–10 mm. long, glabrous.

Distribution: dry open slopes and sage-brush associations, western Wyoming and eastern Idaho, south to northern Utah.

IDAHO: mountain meadows, Lake Henry, Fremont Co., July 15, 1899, *Blankinship* (M, RM); dry soil, Victor, Fremont Co., July 11, 1901, *Merrill & Wilcox 998* (G, NY, RM); Beaver Creek Canyon, Fremont Co., June 28, 1890, *Rydberg* (NY); Beaver Creek Canyon, Fremont Co., June 27, 1895, *Shear 3037* (NY); hills, Beaver Creek Canyon, Fremont Co., June 27, *Shear 3008* (NY); dry open slopes, Caribou Mts., Bonneville Co., July 17, 1923, *Payson & Armstrong 3507* (G, M, RM, Ph); Oxford, Oneida Co., May 9, 1885, *Leonard* (G).

WYOMING: Union Pass, Wind River Mts., Fremont Co., Aug. 10, 1894, *Nelson 4015* (RM); sagebrush slopes, 20 mi. east of Big Piney, Sublette Co., July 9, 1922, *Payson & Payson 2605* (G, M, Ph, RM, U CAL, NY); headwaters of the Hoback River, Lincoln Co., alt. 8000 ft., July 18, 1933, *Williams 1317* (M); Gros Ventre Mts., Teton Co., alt. 8500 ft., Aug. 29–Sept. 6, 1900, *Curtis* (NY).

UTAH: Parley's Cañon near Salt Lake City, Salt Lake Co., alt. 8000 ft., July 1, 1898, *Jones 6407* (M); Parley's Canyon near Salt Lake City, June 23, 1922, *Osterhout 6212* (RM); Ft. Douglas, Salt Lake Co., May 5, 1908, *Clemens* (Ph); Red Butte, April 24, 1908, *Clemens* (G, M); Red Rock Canyon, Salt Lake Co., June 11, 1905, *Rydberg 6082* (NY, RM); Wasatch Mts., alt. 5000 ft., May, 1869, *Watson 597* (G, NY); South Weber, Weber Co., May 31, 1917, *Jones 487* (G); Lewiston to

Club River, May 8, 1911, *Smith 2366* (NY); Midway, Wasatch Co., June 15, 1933, *Eastwood & Howell 507* (M).

10a. var. **idahoensis** W. M. Sharp, var. nov.[13]

Leaf-segments 3–6 cm. long, 1–2.5 cm. broad, coarsely serrate-dentate or incised, acute, uniformly crisp-pilose to pilose-tomentose on both surfaces; petioles pilose-tomentose; bracts of the involucre usually shorter than the disk, lanceolate, 1–2 cm. long, pilose to pilose-tomentose; in all other characters similar to the species.

Distribution: known only from Boise Co., western Idaho.

IDAHO: rocky ground, Squaw Creek, Boise Co., alt. 3500 ft., May 8, 1911, *Macbride 820* (F, G, M TYPE, NY, RM, U CAL).

The variety *idahoensis* may be distinguished from the species *Balsamorhiza macrophylla* by the smaller and shallowly incised leaf-segments, the uniformly pilose leaf-surface, the pilose-tomentose petioles, and the short involucral bracts.

11. Balsamorhiza serrata Nels. & Macbr. in Bot. Gaz. **56**: 479. 1913.

Stems scapose, unbranched, 1–3.5 dm. high, crisp-pilose, with hirsute-hispidulous hairs intermixed; leaves chiefly basal, lanceolate to ovate-lanceolate, 0.6–3 dm. long, 2–10 cm. broad, dentate- to serrate-subuliferous, acute, strigose to hispidulous on both surfaces, interspersed with minute stiff hairs, conspicuously reticulate-veined, coriaceous; heads solitary, 5–8 cm. broad including the rays; bracts of the involucre linear-lanceolate, about as long as the disk, subuliferous, tomentose to crisp-pilose, herbaceous; rays yellow, oblong, 2.5–3.5 cm. long, 6–8 mm. broad, bidentate, tube and outer surface of lamina hirsutulous to glabrate; achenes linear-oblong, 6–7 mm. long, glabrous, epappose.

Distribution: dry rocky ground, Columbia Co., Washington, to Morrow and Wasco Counties, south to Harney and Lake Counties, Oregon.

[13] **B. macrophylla** var. **idahoensis** W. M. Sharp, var. nov., segmentis folii 3–6 cm. longis, 1–2.5 cm. latis, serrato-dentatis vel incisis, acutis, utrinque piloso-crispis vel piloso-tomentosis; petiolis piloso-tomentosis; bracteis involucri disco brevioribus, lanceolatis, 1–2 cm. longis, pilosis vel piloso-tomentosis. Cetera speciei similis.—Collected on rocky ground, Squaw Creek, Boise Co., Idaho, alt. 3500 ft., May 8, 1911, *Macbride 820* (F, G, M TYPE, NY, RM, U CAL).

WASHINGTON: Blue Mts., Columbia Co., July 9, 1913, *Darlington 54* (G, RM).

OREGON: Union Co., 1887, *Cusick 595, 1031* (G); upper Tygh Valley, Wasco Co., April 23, 1933, *Bellinger* (WU); dry ground near Shaniko, Wasco Co., May 5, 1928, *Gale 100* (M); dry stony ground, 10 mi. north of Wapinitis, Wasco Co., May 29, 1933, *Peck 17393* (WU); rocky hills near Rock Creek, Morrow Co., alt. 1090 m., May 19, 1894, *Leiberg 83* (G, M, NY, RM TYPE); near Rhea Creek, vicinity of Lexington, Morrow Co., alt. 605 m., May 12, 1894, *Leiberg 58* (F, G, M, NY, RM); John Day Valley, May 16, 1885, *Howell* (F, G, NY, Ph); dry rocky mountain top near Fossel, Wheeler Co., June 3, 1925, *Henderson 5248* (G); mesa, between Warner Valley P. O. and Big Lake, Lake Co., alt. 1600 m., June 16, 1911, *Eggleston 6964* (NY); dry sterile soil, Lakeview, Lake Co., June 27, 1927, *Peck 15264a* (M, WU); stony flat on Stein's Mts., Harney Co., June 30, 1898, *Cusick 1984* (F, G, M, U CAL); Silver Creek meadows, 6 mi. west of Ripley, Harney Co., June 22, 1925, *Peck 13900* (WU); near Harper Ranch, alt. 1000 m., May 22, 1896, *Leiberg 2106* (G, NY, U CAL).

12. **Balsamorhiza hispidula** W. M. Sharp, sp. nov.[14]

Stems 0.6–3 dm. high, pilose-hirsute, glandular; leaves 1–4 dm. long, pinnately divided, the segments unequally pinnately cleft or parted, 2–4.5 cm. long, acute, green on both surfaces, above sparsely hispid, hispid-pilose to hispidulous, glandular, beneath globular-resinous and usually hispid, hispidulous or hispid-pilose on the veins; petioles pilose-hirsute to pilose-hispid, glandular; heads radiate, solitary, 4.5–6 cm. long including the rays; bracts of the involucre linear to linear-lanceolate, about as long as the disk, the outer series as long as or longer than the inner series, more or less pilose-hirsute-ciliate, acute to acuminate, the outer surface interspersed by numerous glands; rays yellow, bidentate, 2.5–3 cm. long, tube and outer surface of lamina hirtellous; achenes 6–7 mm. long, glabrous, epappose.

Distribution: dry grounds, southwestern Wyoming, Idaho and northern Utah, west to Nevada.

WYOMING: South Butte, "thirteen mile," July 17, 1897, *Nelson 3552* (RM).

IDAHO: vicinity of Pocatello, Bannock Co., 1921, *Soth 7* (NY); hills near Oxford,

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[14] **B. hispidula** W. M. Sharp, sp. nov., caulibus 0.6–3 dm. altis, piloso-hirsutis et glandulosis; foliis 1–4 dm. longis pinnatisectis, segmentis inaequaliter pinnatifidis vel pinnatipartitis, 2–4.5 cm. longis, acutis, utrinque viridibus, supra sparse hispido-pilosis vel hispidulis et glandulosis, subtus globuloso-resinosis et plerumque hispidis, in nerviis hispidulis vel hispido-pilosis; petiolis piloso-hirsutis vel piloso-hispidis, glandulosis; bracteis involucri disco aequalibus, linearibus vel lineari-lanceolatis, plus minusve piloso-hirsuto-ciliatis et glandulosis, acutis vel acuminatis.—Collected at Lake Point, Tooele Co., Utah, alt. 4300 ft., May 20, 1880, *Jones 1727* (F, NY, RM, U CAL TYPE).

Bannock Co., May 16, 1885, *Leonard 45* (NY); gravelly waste ground, Twin Falls, Twin Falls Co., May 9, 1912, *Bennitt* (RM).

UTAH: Big Cottonwood Canyon, vicinity of Salt Lake City, May 23, 1908, *Clemens* (F, Ph); Fort Douglas, Salt Lake Co., May 5, 1908, *Clemens* (F); vicinity of Salt Lake City, Salt Lake Co., 1883, *Meehan* (M, Ph); Garfield, Salt Lake Co., alt. 4300 ft., May 30, 1884, *Leonard 66* (G, NY); west of Taylorsville, Salt Lake Co., May 4, 1916, *Jones 314* (G); Murray, Salt Lake Co., May 10, 1915, *Jones* (U CAL); Antelope Is., Davis Co., alt. 5500 ft., June, 1869, *Watson 596* (NY, G); western slopes of the Wasatch Range, Springville, Utah Co., alt. 4400–5000 ft., May 17, 1913, *Hill* (M); Tintic, Juab Co., May 16, 1891, *Jones* (M, U CAL); Lake Point, Tooele Co., alt. 4300 ft., May 20, 1880, *Jones 1727* (F, NY, RM, U CAL TYPE); "Hugway," May 29, 1891, *Jones* (NY); St. George, Washington Co., 1877, *Palmer 236* (F, G, M, NY).

NEVADA: Pinon-Juniper Assoc., 3 mi. west of Baker, White Pine Co., alt. 6500 ft., June 16, 1933, *Maguire & Becraft 2840* (M); 1891, *Jones* (M); Emigrant Pass, Eureka Co., June 10, 1933, *Eastwood & Howell 203* (M).

13. **Balsamorhiza hirsuta** Nutt. in Trans. Am. Phil. Soc. II, **7**: 349. 1841; Torr. & Gray, Fl. N. Am. **2**: 301. 1842; Walp. Rep. Bot. Syst. **2**: 610. 1843; Gray, Syn. Fl. N. Am. **1**^{2}: 266. 1884; Howell, Fl. Northwest Am. **1**: 340. 1900; Piper in Contr. U. S. Nat. Herb. [Fl. State Wash.] **11**: 581. 1906; Rydb. Fl. Rocky Mts., ed. 2, 929. 1922, in part; Blake in Contr. U. S. Nat. Herb. [Tidestrom's Fl. Utah & Nevada] **25**: 583. 1925, in part; Jepson, Manual Fl. Pl. Cal. 1078. 1925, in part.

Balsamorhiza Hookeri var. *hirsuta* (Nutt.) Nels. in Coult. & Nels. Bot. Rocky Mts. 546. 1909.

Stems subscapose, 1.5–4.5 dm. high, hirsute to hirsute-pilosulous, and glandular; leaves lanceolate to oblong-lanceolate, pinnately divided, 1.5–4.5 dm. long, the divisions pinnatisect or bipinnatisect, 2.5–6 cm. long, .5–2.5 cm. broad, the ultimate segments linear to lanceolate, acute, both surfaces green, strigose-hirsute, and glandular; petioles strigose-hirsute; heads solitary, radiate, 5–9 cm. broad including the rays; bracts of the involucre 3–4-seriate, erect or somewhat spreading, ovate-attenuate to an acute apex, as long as or shorter than the disk, pilose-ciliate, hirsute; rays yellow, oblong-lanceolate, 2.5–4 cm. long, 7–8 mm. broad, bifid or entire, tube and outer surface of lamina pubescent; disk-corollas 8–9 mm. long, the limb hirsutulous; achenes linear-oblong, 5–6 mm. long, glabrous.

Distribution: dry open grounds, southeastern Washington to northeastern Oregon.

WASHINGTON: east of Walla Walla, Walla Walla Co., 1834, *Nuttall* (G, TYPE collection).

OREGON: summit of Cabbage Hill, east of Pendleton, Umatilla Co., June 14, 1928, *Thompson 4863* (G, M); dry ground, Hot Lake, Union Co., May 19, 1923, *Sherwood 363* (F, WU); Hot Lake, Union Co., May 19, 1923, *Sherwood 268* (WU); dry rocky hillsides, Union Co., alt. 3500 ft., June–July, 1881, *Cusick 441* (F, G); northeastern Oregon, May 20, 1898, *Cusick 1872* (F, G, M, RM, U CAL); stony ridge, "mouth of Ladd Canyon," northeastern Oregon, June 7, 1898, *Cusick 1921* (F, G, M, U CAL).

13a. var. **lagocephala** W. M. Sharp, var. nov.[15]

Stems 0.6–2.5 dm. high, pilose, intermixed with numerous short hairs; leaves pinnately cleft or divided, 1–2 dm. long, the divisions 1–2 cm. long, 0.5–1.5 cm. broad, cleft into three or more ascending, acute lobes, hirsute on both surfaces, often densely interspersed with glands; bracts of the involucre lanceolate, shorter than the disk, the outer series progressively shorter than the inner series, acute, densely tomentose or pilose-tomentose, especially towards the base of the involucre; in other characters similar to the species.

Distribution: rocky sagebrush habitats in Lincoln, Grant, and Kittitas Counties of central Washington.

WASHINGTON: Davenport, Lincoln Co., alt. 2500 ft., May 20, 1905, *Jones* (NY); rocky hillside, Ephrata, Grant Co., April 13, 1924, *St. John, Pickett, Cary & Warren 6314* (Ph); rocky sagebrush plains near Coulee City, Grant Co., May 2, 1931, *Thompson 6163* (G); "Rimrock scabland," north of Ellensberg, Kittitas Co., April 23, 1932, *Thompson 8229* (M TYPE, NY); sandy soil, Ellensberg, Kittitas Co., May 20, 1897, *Piper 2718* (G); sage-brush slopes near Vantage, Kittitas Co., April 23, 1932, *Thompson 8212* (NY, RM).

13b. var. **neglecta** W. M. Sharp, var. nov.[16]

Leaf-segments linear-lanceolate to lanceolate, 2–4 cm. long,

[15] **B. hirsuta** var. **lagocephala** W. M. Sharp, var. nov., caulibus 0.6–2.5 dm. altis, pilosis et hispidulis; foliis pinnatifidis vel pinnatisectis, 1–2 dm. longis, segmentis 1–2 cm. longis, 0.5–1.5 cm. latis, adscendentibus, acutis, utrinque hirsutis, saepe glandulosis; bracteis involucri lanceolatis, disco brevioribus, exterioribus interiorbus plus minusve brevioribus, acutis, dense tomentosis vel piloso-tomentosis, praesertim ad basem involucri. Cetera speciei similis.—Collected at "Rimrock scabland," north of Ellensberg, Kittitas Co., Washington, April 23, 1932, *Thompson 8229* (M TYPE, NY).

[16] **B. hirsuta** var. **neglecta** W. M. Sharp, var. nov., segmentis folii lineari-lanceolatis vel lanceolatis, 2–4 cm. longis, 1–1.5 cm. latis, integris vel pinnatisectis, adpresso-hirsutis; bracteis involucri disco aequalibus, linearibus vel anguste lineari-lanceolatis, dense piloso-tomentosis vel tomentosis. Cetera speciei similis.—Collected at Truckee Pass, Washoe Co., Nevada, alt. 4450 ft., May 1, 1909, *Heller 9592* (F TYPE, G, NY, Ph).

1–1.5 cm. broad, entire to pinnately parted, appressed-hirsute; bracts of the involucre about as long as the disk, linear to narrowly linear-lanceolate, densely pilose-tomentose to tomentose; in all other characters similar to the species.

Distribution: dry grounds, northeastern Utah west to Washoe Co., Nevada.

UTAH: Sheep Creek Canyon, Daggett Co., June 4, 1932, *Williams 520* (NY, RM); near Fort Duchesne, Uinta Co., 1913, *Carter 4* (RM).

NEVADA: Truckee Pass, Washoe Co., alt. 4450 ft., May 1, 1909, *Heller 9592* (F TYPE, G, NY, Ph); Trinity Mts., Humboldt Co., May, 1868, *Watson 595* (G, NY); near Carson City, Ormsby Co., 1864, *Anderson 69* (G); north of Carson City, May, 1865, *Stretch 156* (NY).

14. **Balsamorhiza terebinthacea** (Hook.) Nutt. in Trans. Am. Phil. Soc. II. **7**: 349. 1841; Walp. Rep. Bot. Syst. **2**: 610. 1843; Gray in Mem. Am. Acad. [Pl. Fendl.] N. S. **4**: 82. 1848, in part; Gray, Syn. Fl. N. Am. **1**^{2}: 266. 1884; Howell, Fl. Northwest Am. **1**: 340. 1900; Piper in Contr. U. S. Nat. Herb. [Fl. State Wash.] **11**: 581. 1906; Rydb. Fl. Rocky Mts., ed. 2, 929. 1922, in part.

Heliopsis (?) *terebinthacea* Hook. Fl. Bor.-Am. **1**: 310. [1834] 1840; DC Prodr. **5**: 551. 1836.

Stems subscapose, 2.5–5 dm. tall, crisp-hirsute or crisp-pilose, glandular; leaves lanceolate or oblong-lanceolate, thick, 2–4 dm. long, 5–10 cm. broad, pinnately cleft or parted, the lobes sparsely dentate-serrate or entire, acute, strigose-hirsute on both surfaces; heads solitary, 4–6 cm. broad including the rays; bracts of the involucre linear-lanceolate to ovate-lanceolate, about as long as the disk, acute, crisp-pilose to crisp-hirsute, herbaceous; rays yellow, oblong-cuneate, 2.5–3.5 cm. long, 6–9 mm. broad towards the apex, tube and outer surface of the lamina pubescent; achenes 7–8 mm. long, glabrous, epappose.

Distribution: southwestern Washington, south to Siskiyou County, California.

WASHINGTON: low ground in open pine woods, Falcon Valley, Klickitat Co., June 17, 1922, *Suksdorf 10866* (G, M, NY, Ph, U CAL); Klickitat River, May 18, 1884, *Suksdorf 360* (G); low grounds in pine woods, Falcon Valley, *Suksdorf 135* (G); foothills of Cascade Mts., Yakima Region, 1882, *Brandegee 96* (M, U CAL); near Fort Vancouver, "1825," *Douglas* (K TYPE).

OREGON: dry stony slope, 12 mi. west of Waldo, Josephine Co., July 2, 1918, *Peck 8456* (WU).

CALIFORNIA: Shasta Valley, Siskiyou Co., May 10, 1910, *Butler 1337* (U CAL).

GREENMANIELLA W. M. Sharp

Greenmaniella W. M. Sharp, gen. nov.[1]

Perennial suffruticose plants with alternate ovate leaves. Heads heterogamous, medium-sized, disposed in subcorymbose clusters. Involucral bracts 2–3-seriate, the outermost series herbaceous or subherbaceous, the two inner series membranaceous, marked by six or more brownish-resinous parallel nerves. Receptacle narrowly conical; pales concave to semiconduplicate, membranaceous with several brownish resinous parallel nerves. Ray-flowers styliferous and fertile, rays light yellow; disk-flowers fertile, tube narrowly cylindrical, the base narrowed and seated inside the cup-like crown of the achene, limb campanulate, 5-lobed. Anther appendages ovate, base subsagittate; style-branches recurved, obtuse or acute, pubescent towards the apex. Achenes subfusiform, broadly subangulate, sparsely carunculate. Pappus a shallow cup-like crown, with knob-like projections at the angles.

Greenmaniella resinosa (Watson) W. M. Sharp, comb. nov. *Zaluzania resinosa* Watson in Proc. Am. Acad. **25**: 153. 1890; Rob. & Greenm. in Proc. Am. Acad. **34**: 533. 1899.

Plants suffrutescent, 1.5–2.5 m. tall; stems branched above, sulcate, pilose-tomentulose; leaves ovate, 0.5–3 dm. long, 2–14 cm. broad, serrate-mucronate, acuminate, acute at the base, triple-veined, substrigose-hirsute above, subpilose on the veins below, interspersed by numerous resinous globules; heads 6–8 mm. high.

[1] **Greenmaniella** W. M. Sharp, gen. nov. Capitula heterogama, radiata, floribus radii uniseriatis et floribus disci fertilibus. Involucrum subcampanulatum, bracteis 2–3-seriatis, exterioribus herbaceis, interioribus submembranaceis striatisque. Receptaculum anguste conicum, paleis concavis vel subconduplicatis, membranaceis striatisque marginibus plus minusve scariosis. Corollae radii ligulae patentes, integrae, apici dentatae. Corollae disci tubulo-campanulatae, regulares, tubo basi non dilatato, limbo late campanulato 5-dentato. Antherae basi subsagittatae, apici appendiculatae. Styli rami complanati, elongati, obtusi vel acuti. Achenia disci subfusiforma, subtetragona, breve coronata.—Plantae verisimilliter suffruticosae, foliis alternatis.

Distribution: Nuevo Leon in the Sierra Madre near Monterey, Mexico.

Mexico: Nuevo Leon—Sierra Madre, near Monterey, Aug. 24, 1889, *Pringle 2412* (F, G type, M, U CAL, US); Sierra Madre, above Monterey, 3000 ft. alt., Aug. 25, 1903, *Pringle 11615* (F, G, US); Sierra Madre, "Conquor," near Monterey, July 9, 1888, *Pringle 2222* (G); vicinity of Monterey, 750 m. alt., Aug. 1911, *Arsène 6176* (M).

List of Exsiccatae

The collectors' numbers are indicated by *italics;* the collections without numbers are indicated by a dash. The numbers in parentheses refer to the species number used in this monographic study. The genus, in each case, precedes its list of exsiccatae.

BALSAMORHIZA

Abrams, L. R., & E. A. McGregor. *356, 833* (4).
Anderson, C. L. *69* (13b).
Anderson, F. W. — (5).
Austin, R. M. *94, 47* (5);—, — (7).
Austin, R. M. & Bruce. *2179* (7).
Ayres, W. B. *63* (5).
Baker, C. F. *51, 926* (5).
Baker, M. S. & F. P. Nutting. —(7).
Bellinger, G. C. — (11).
Bennitt, D. *28* (12).
Bigelow, J. M. — (4); — (8).
Blankinship, J. W. — (4); *52* (5); — (10).
Bolander, H. N. *4526* (2); *6187* (5).
Brandell, E. M. — (4).
Brandegee, K. — (1); — (4); *208* (8); *2469* (8).
Brandegee, T. S. — (1); *891* (3); —, — (4); *1077* (5); *96* (11).
Butler, G. D. *1180, 595* (4); *1157* (6b); *1337* (14).
Canby, W. M. *189* (9a).
Carter, W. R. — (4); *4* (13b).
Chandler, H. P. *914* (8).
Clark, J. A. *28* (5).
Clemens, Mrs. Jos. — (5); —, — (10); —, — (12).
Congdon, J. W. —, — (2); — (8).
Cooper, R. D. *1182* (5).
Cotton, J. S. *1105, 1052, 976* (3); *336* (4); *568* (6a).
Crandall, C. L. *2723* (5).
Culbertson, J. W. *4413* (1).
Curtis, C. C. — (10).
Cusick, W. C. *595, 3255, 1679, 3332,* (3); *1984* (11); *441, 1872, 1921* (13).
Darlington, H. T. *54* (11).
Davidson, A. *2058* (1).
Davy, J. B. *2185* (4).
Douglas, D. — (14).
Drake & Dickson. — (4).
Drew, E. R. — (7).
Dudley, W. B. *363* (4).
Eastwood, A. *11927, 3237* (4); *896* (7).
Eastwood, A. & T. Howell. *203* (12); *507* (10).
Eggleston, W. W. *6820* (4); *6964* (11).
Elmer, A. D. E. *4374* (8).
Engelmann, G. — (5).
Ferris, R. S. *1580* (4).
Gabrielson. — (5).
Gale, N. P. *111* (4); *178,* — (9); *100* (11).
Gardner, N. S. — (4).
Gorman, M. W. — (4).
Grant, J. M. —(4).
Greene, E. L. — (2); *718* (4); *745* (6b).
Griffiths, D. & J. S. Cotton. *483* (3).
Griffiths, D. & B. Hunter. *77* (9).
Hall, E. *276* (4).
Hall, H. M. *6263, 8907, 11246, 7797* (4); *1032* (7); *8885* (8).
Hall, H. M. & G. R. *8340* (1).
Hall, H. M. & H. D. Babcock. *5100* (4).

Hall, H. M. & H. P. Chandler. *7304* (4).
Hammond, E. W. *209* (4).
Hansen, G. *168* (2); *420* (5); *1069* (8).
Hayden, F. V. —, — (9).
Heller A. A. *11977*, *7802* (4); *14594*, *12026* (5); *9592* (13b).
Heller, A. A. & E. G. *2958* (5); *3298* (9).
Henderson, L. F. *362*, *5902* (4); *5703* (7); *5248* (11).
Hill, G. R. — (12).
Holmes, F. — (4).
Horner, R. M. *B277* (5); — (9).
Howell, T. J. —, — (4); —, —, — (6); — (7); — (11).
Jack, J. G. — (9).
Jones, A. J. — (12).
Jones, M. E. — (3); *6407* (10); —, *1727*, — (12); — (13a).
Jones, W. W. *487* (8); — (9); —, *314* (12).
Kammerer, A. L. *60* (4).
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Explanation of Plate

PLATE 5

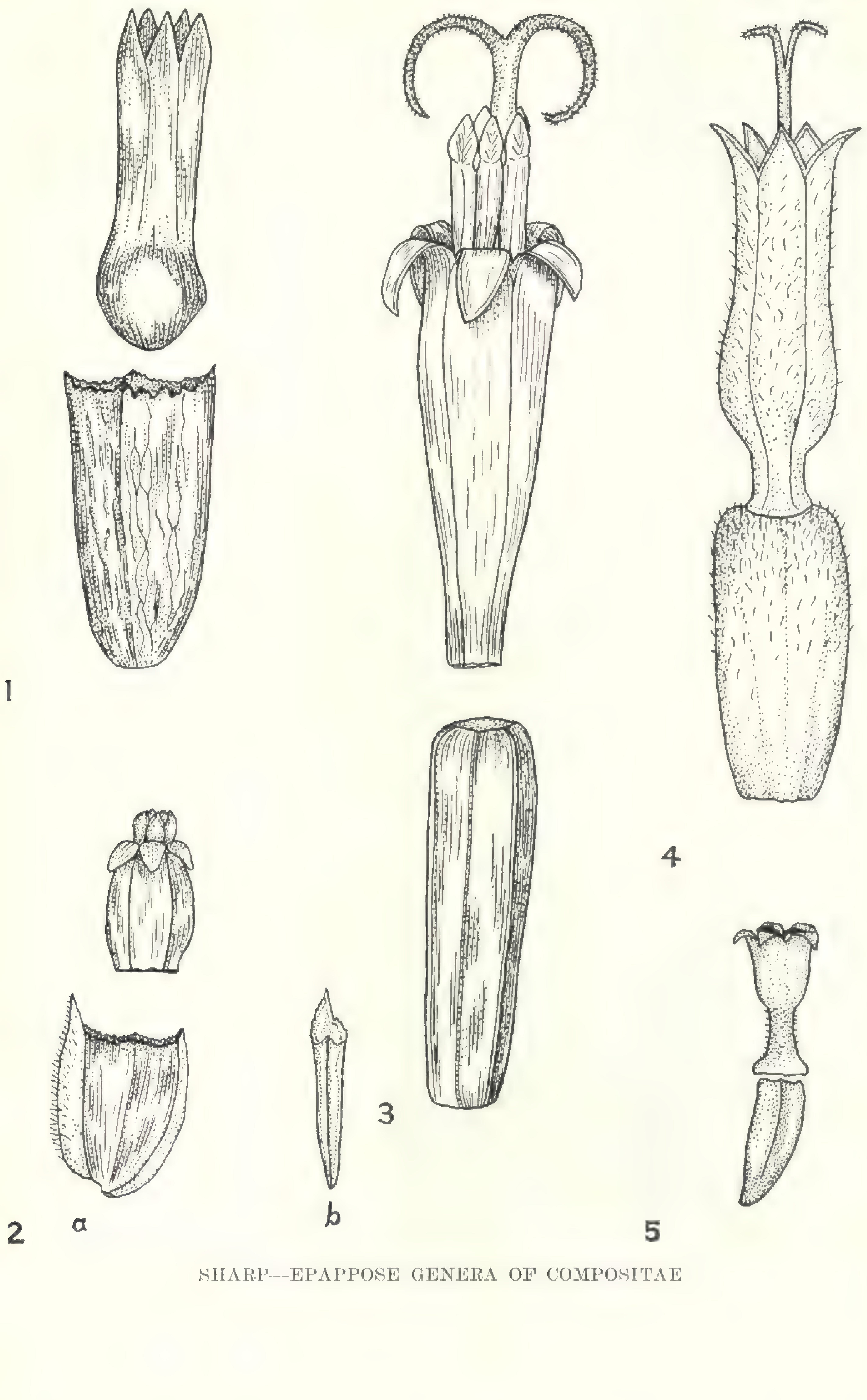
Fig. 1. Disk-flower of *Echinacea pallida*. Corolla above, achene below. × 11.

Fig. 2. Disk-flower of *Ratibida columnaris*. a. Achene, side view. b. Achene, edge view. × 9.

Fig. 3. Disk-flower of *Balsamorhiza hispidula*. Corolla above, achene below. × 9.

Fig. 4. Disk-flower of *Iostephane heterophylla*. × 7.5.

Fig. 5. Disk-flower of *Zaluzania mollissima*. × 9.



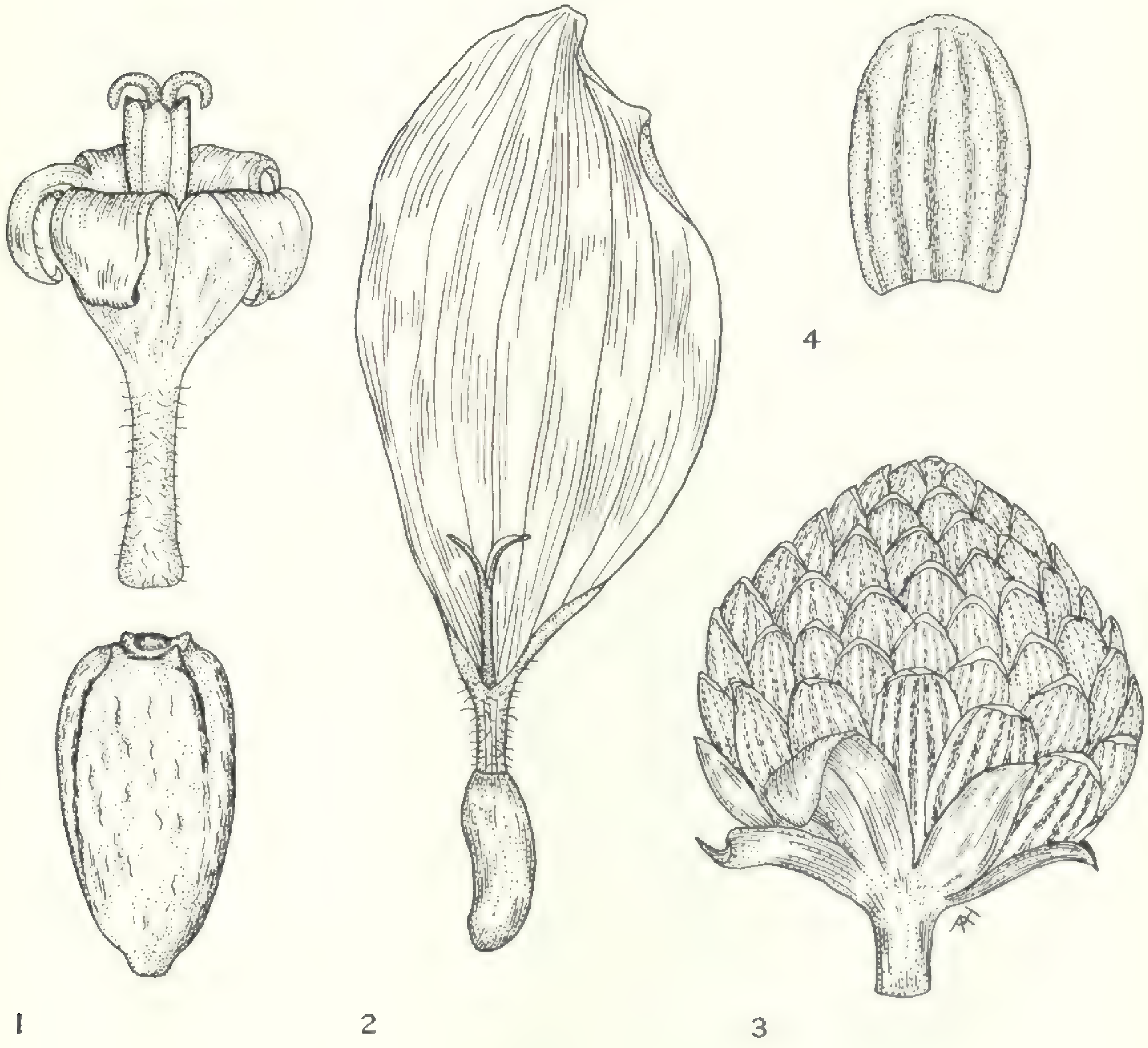
SHARP—EPAPPOSE GENERA OF COMPOSITAE

Explanation of Plate

PLATE 6

Greenmaniella resinosa

Fig. 1. Disk-flower, corolla above, achene below. × 9.
Fig. 2. Ray-flower. × 13.5
Fig. 3. Disk, showing the striated pales. × 9.
Fig. 4. Pale, with the scarious apex. × 13.5.



SHARP—EPAPPOSE GENERA OF COMPOSITAE

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STUDIES IN THE APOCYNACEAE. IV[1]

The American Genera of Echitoideae

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V. Forsteronia G. F. W. Meyer

Forsteronia G. F. W. Meyer, Fl. Esseq. 133. 1818; A. DC. in DC. Prodr. **8**: 436. 1844; Muell.-Arg. in Mart. Fl. Bras. **6**[1]: 95. 1860; Benth. & Hook. Gen. Pl. **2**: 710. 1876; Miers, Apoc. So. Am. 242. 1878; K. Sch. in Engl. & Prantl, Nat. Pflanzenfam. **4**[2]: 187. 1895.

Syringosma Mart. ex. Rchb. Consp. 134. 1828.

Thyrsanthus Benth. in Hook. Jour. Bot. **3**: 245. 1841; A. DC. loc. cit. 386. 1844; Miers, loc. cit. 93. 1878, nec Ell. nec Schrank.

Aptotheca Miers, loc. cit. 150. 1878.

Lactescent, fruticose or suffruticose lianas. Stems volubile, terete, the branches opposite or alternate. Leaves opposite, or infrequently ternate or quaternate in certain species, entire, penninerved, the upper surface bearing few to several glandular emergences at the base of the midrib, or eglandular, the lower surface bearing with more or less constancy a single rather inconspicuous, lenticular foveum or pit in the axils of the midrib and principal primary veins; nodes inconspicuously

[1] Continued from Ann. Mo. Bot. Gard. **20**: 605–790. (1)–(186). 1933.

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stipulate. Inflorescence terminal or both terminal and lateral, aggregate dichasial to thyrsiform (simple in *F. simulans*). Calyx 5-parted, the lobes essentially equal, cleft nearly to the receptacle, imbricated, bearing within one to several squamellae, or the squamellae evidently lacking. Corolla rotate or subrotate, the tube relatively short, exappendiculate within, the orifice not annulate, the limb actinomorphic, 5-parted, dextrorsely, or rarely sinistrorsely, convolute. Stamens 5, the anthers wholly exserted to essentially included, connivent and agglutinated to the stigma, consisting of 2 parallel, uniformly fertile sporangia borne ventrally near the apex of an enlarged, sagittate, peltate connective; pollen granular; filament free or agglutinated to the style. Carpels 2, apocarpous, or very rarely syncarpous, united at the apex by the fusiform or subcapitate stigma; ovules many, several-seriate, borne upon an axile, binate placenta. Nectaries 5, separate or more or less concrescent. Follicles 2, apocarpous, or more or less agglutinated, dehiscing along the ventral suture, containing many dry, truncate, apically comose seeds.

Type species: *Forsteronia spicata* (Jacq.) G. F. W. Meyer, Fl. Esseq. 133. 1818.

KEY TO THE SUBGENERA

A. Stamen filaments exappendiculate .... Subgen. I. Euforsteronia
AA. Stamen filaments with conspicuous, membranaceous appendages above .... Subgen. II. Pteranthera

Subgen. I. Euforsteronia Woodson, subgen. nov.

Stamen filaments exappendiculate, the anthers merely acuminate with more or less evident, hyaline tips. *Spp. 1–46.*

KEY TO THE SPECIES

a. Anther-tips exserted, often barely so, or essentially included; filaments distinct and free, not agglutinated to the style.
b. Anthers 0.07–0.1 cm. long, the tips barely exserted or essentially included.
c. Ultimate branches of the inflorescences regularly and determinately composed, not indefinitely congested.
d. Leaves cordate, usually obscurely so.
e. Corolla-lobes minutely papillate or essentially glabrous within; anther-tips minutely barbellate; plants of British Guiana and northern Brazil .... *1. F. gracilis*

ee. Corolla-lobes conspicuously pilosulose within; anther-tips glabrous or essentially so; plants of southern Brazil............*2. F. pilosa*

dd. Leaves not cordate.

e. Anther-tips glabrous or essentially so.

f. Corolla 0.2–0.25 cm. long........................*3. F. Luschnathi*

ff. Corolla 0.3–0.35 cm. long..........................*6. F. Gardneri*

ee. Anther-tips abundantly barbellate.

f. Calyx-lobes ovate-deltoid, obtuse; squamellae numerous, indefinitely and regularly distributed; plants of Venezuela and Colombia.....................................*4. F. elachista*

ff. Calyx-lobes lanceolate to ovate-lanceolate, acute to acuminate; squamellae relatively few, in alternate groups; plants of Peru ....*5. F. graciloides*

cc. Ultimate branches of the inflorescences indefinitely congested, at least the lower...*7. F. affinis*

bb. Anthers 0.125–0.2 cm. long, the tips usually manifestly exserted.

c. Stem and leaves ferruginous-tomentulose.........................*8. F. rufa*

cc. Stem and leaves glabrous or essentially so.

d. Ovary manifestly 2-lobed, apocarpous.

e. Inflorescences typically thyrsiform or corymbose.

f. Stigma wholly included among the connate anthers.

g. Leaves glandular at the base of the midrib above.

h. Calyx-lobes somewhat shorter than the corolla-tube to very slightly longer; species of Central and South America.

i. Anther-tips more or less barbellate; leaves 8–20 cm. long.

j. Leaves membranaceous; plants of the Guianas and Trinidad...............................*9. F. Acouci*

jj. Leaves coriaceous or subcoriaceous.

k. Corolla very minutely and irregularly papillate to essentially glabrous without; plants of northern Brazil and adjacent Peru..........*10. F. Benthamiana*

kk. Corolla densely and uniformly puberulent-papillate without; plants of British Honduras..*11. F. viridescens*

ii. Anther-tips glabrous; leaves 3–9 cm. long.

j. Inflorescences pyramidal; calyx-lobes ovate, acute to acuminate; plants of the Guianas and the lower Amazon Valley.....................*12. F. guyanensis*

jj. Inflorescences corymbose; calyx-lobes ovate to ovate-deltoid, obtuse or rounded; plants of northeastern Brazil and the upper Amazon Valley.....*13. F. brevifolia*

hh. Calyx-lobes much longer than the corolla-tube; plants of Jamaica..................................*14. F. Wilsonii*

gg. Leaves eglandular.

h. Leaves heavily coriaceous; calyx-lobes 0.175–0.3 cm. long ....*15. F. diospyrifolia*

hh. Leaves firmly membranaceous; calyx-lobes 0.08–0.12 cm. long.....................................*16. F. Riedelii*

ff. Stigma somewhat exserted beyond the connate anthers.

g. Inflorescences about as long as the subtending leaves, or nearly so, relatively lax and diffuse; calyx-lobes 0.075–0.1 cm. long, obtuse or rounded............................17. *F. Duckei*

gg. Inflorescences much shorter than the subtending leaves, relatively congested; calyx-lobes 0.1–0.17 cm. long, acute to acuminate..................................18. *F. laurifolia*

ee. Inflorescences compound-subspiciform, the branches very short and indefinitely congested..........................19. *F. paludosa*

dd. Ovary superficially more or less 5-lobed by the pressure of the nectaries, more or less completely syncarpous toward the base, the fruit, however, appearing normal and apocarpous.

e. Bracts very conspicuous, as large as the calyx-lobes or somewhat larger, at least in part, more or less foliaceous.

f. Individual pedicels subtended by at least one bract conspicuously larger than the calyx-lobes; plants of Bolivia....20. *F. amblybasis*

ff. Individual pedicels subtended by bracts smaller than the calyx-lobes; plants of Peru..........................21. *F. decipiens*

ee. Bracts relatively inconspicuous throughout, smaller than the calyx-lobes, scarious; plants of east-central Brazil.........22. *F. montana*

aa. Anthers wholly exserted; filaments agglutinated to the style, at least above.

b. Leaves glandular at the base of the midrib above; species of South and Central America (*41* also indigenous to Cuba).

c. Inflorescences aggregate dichasial to thyrsiform, obviously compound.

d. Ovary apocarpous; fruit bifollicular; species of Central and South America generally.

e. Squamellae numerous, opposite the calyx-lobes or regularly and indefinitely distributed.

f. Corolla 0.4–0.55 cm. long; species of South America generally.

g. Leaves generally puberulent beneath.

h. Calyx-lobes acute to acuminate.

i. Inflorescences rather narrow, usually much longer than broad; corolla essentially glabrous without..23. *F. pubescens*

ii. Inflorescences subcorymbose, broader than long; tips of the corolla-lobes conspicuously puberulent-papillate without................................24. *F. cordata*

hh. Calyx-lobes broadly obtuse or rounded............25. *F. mollis*

gg. Leaves glabrous beneath, or merely minutely barbellate in the axils of the midrib.

h. Corolla essentially glabrous without.

i. Calyx-lobes acute to acuminate.

j. Leaves obscurely cordate, wholly glabrous beneath; plants of Ecuador....................26. *F. subcordata*

jj. Leaves obtuse or rounded at the base, minutely barbellate in the axils of the midrib beneath; plants of eastern Brazil......................27. *F. leptocarpa*

ii. Calyx-lobes broadly obtuse or rounded.

j. Peduncles and pedicels densely and conspicuously puberulent to tomentulose.

k. Leaves 7–12 cm. long, 4.0–7.5 cm. broad; corolla-lobes very minutely papillate or essentially glabrous within; plants of northern Bolivia......*25. F. mollis*

kk. Leaves 3.5–10.0 cm. long, 2.0–5.5 cm. broad; corolla-lobes puberulent within; plants of southern Brazil ....*28. F. australis*

jj. Peduncles and pedicels very minutely and indefinitely papillate to essentially glabrous.

k. Leaves rather delicately membranaceous, 4.5–8.0 cm. long, 2–4 cm. broad; plants of Venezuela............ ....*29. F. obtusiloba*

kk. Leaves subcoriaceous to firmly membranaceous, 3.0–6.5 cm. long, 1.2–2.7 cm. broad; plants of southern Brazil and adjacent Bolivia, Paraguay, Argentina, and Uruguay......................*30. F. glabrescens*

hh. Corolla densely puberulent or puberulent-papillate without ....*31. F. tarapotensis*

ff. Corolla 0.35–0.37 cm. long.

g. Corolla white, the lobes minutely and rather irregularly pilosulose within; plants of Central America....*32. F. myriantha*

gg. Corolla yellowish-green, the lobes glabrous within; plants of northwestern Peru............................*33. F. galbina*

ee. Squamellae alternate with the calyx-lobes, solitary, or infrequently in groups of 2–3.

f. Bracts conspicuous, and more or less foliaceous (except in *37*), persistent, at least in part.

g. Bracts conspicuous, as large as the calyx-lobes or larger, at least in part.

h. Species of South America.

i. Inflorescences rather narrowly thyrsiform; follicles 13–25 cm. long.........................*34. F. thyrsoidea*

ii. Inflorescences subcorymbose-thyrsiform; follicles 5–10 cm. long..............................*35. F. Velloziana*

hh. Plants of Central America; inflorescences thyrsiform-subspiciform, the lateral branches virtually lacking; follicles unknown..............................*36. F. chiriquensis*

gg. Bracts relatively inconspicuous, smaller than the calyx-lobes; inflorescences thyrsiform-subspiciform, the lateral branches virtually lacking; plants of Ecuador........*37. F. Pycnothyrsus*

ff. Bracts inconspicuous, scarious or only slightly foliaceous, caducous.

g. Inflorescences rather narrowly pyramidal; anthers glabrous ....*38. F. adenobasis*

gg. Inflorescences broad and subcorymbose; anther-tips minutely puberulent or barbellate.

h. Leaves densely and minutely tomentulose beneath; calyx-lobes 0.15–0.17 cm. long ....*39. F. umbellata*

hh. Leaves very minutely and inconspicuously puberulent-papillate beneath; calyx-lobes 0.3–0.35 cm. long............ .... *40. F. Sandwithiana*

dd. Ovary syncarpous; fruit a bicarpellary false capsule; plants of Cuba and locally in southern Mexico, Guatemala, Nicaragua and Atlantic coastal Colombia.................................. *41. F. spicata*

cc. Inflorescences densely corymbose or subumbellate, simple.... *42. F. simulans*

bb. Leaves eglandular at the base of the midrib above; species of the Greater Antilles (*44* of British Honduras).

c. Corolla greenish-white.

d. Secondary venation of leaves relatively dense, subhorizontal; plants of Jamaica.................................... *43. F. floribunda*

dd. Secondary venation of leaves relatively distant, broadly arcuate; plants of British Honduras...................... *44. F. peninsularis*

cc. Corolla deep red or somewhat purplish, very rarely pale flesh-colored.

d. Follicles relatively slender, acuminate, reflexed-divaricate, 14–19 cm. long; corolla-lobes glabrous within, or the margins minutely and irregularly ciliolate; plants of Porto Rico.......... *45. F. portoricensis*

dd. Follicles relatively stout and rigid, blunt, sharply divaricate, nearly rectilinear, 11–14 cm. long; corolla-lobes minutely and rather irregularly papillate within, rarely glabrate; plants of Cuba and Hispaniola..................................... *46. F. corymbosa*

1. Forsteronia gracilis (Benth.) Muell.-Arg. in Mart. Fl. Bras. **6**[1]: 101. 1860.

Thyrsanthus ? gracilis Benth. in Hook. Jour. Bot. **3**: 246. 1841; Miers, Apoc. So. Am. 99. 1878.

Stems relatively slender, glabrous, conspicuously lenticellate when fully mature; leaves opposite, shortly petiolate, oblong-elliptic, apex obtusely subcaudate-acuminate, base broadly and rather obscurely cordate, 5–11 cm. long, 3–5 cm. broad, firmly membranaceous, rather inconspicuously glandular at the base of the midrib above, glabrous, or minutely barbellate in the axils of the midrib beneath; petioles 0.4–0.7 cm. long; inflorescence rather loosely thyrsiform, both terminal and lateral, the terminal somewhat surpassing, and the lateral somewhat shorter than the subtending leaves, bearing many small, white flowers; primary peduncle glabrous, ultimate branches regularly and determinately composed, densely and minutely puberulent-papillate; pedicels 0.1–0.2 cm. long, minutely puberulent-papillate; bracts lanceolate, 0.08–0.1 cm. long, scarious; calyx-lobes ovate, acute to acuminate, 0.08–0.15 cm. long, scarious, minutely papillate without, the squamellae ex-

tremely minute, flagelliform, alternate, solitary, or evidently lacking; corolla densely and minutely puberulent-papillate without, the tube 0.05–0.11 cm. long, about 0.05–0.075 cm. in diameter at the base and 0.1–0.12 cm. in diameter at the orifice, minutely villous within at the insertion of the stamens, the lobes ovate-oblong, 0.11–0.2 cm. long, spreading, minutely papillate or essentially glabrous within; stamen filaments 0.02–0.05 cm. long, distinct and free, not agglutinated to the style, the anthers essentially included or the tips barely exserted, 0.07–0.1 cm. long, minutely barbellate; ovary ovoid, apocarpous, about 0.025 cm. long, minutely villosulose; nectaries somewhat shorter than the ovary; stigma blunt, 0.03–0.07 cm. long; follicles rather slender, essentially continuous, somewhat falcate, 24–26 cm. long, glabrous; seeds about 2.5 cm. long, the tawny coma about 4 cm. long.

British Guiana: Moruka River, Pomeroon District, July, 1927, *Cruz 4584* (FM, MBG, NY, US); Wanama River, Northwest District, May 10–23, 1923, *Cruz 3924* (FM, MBG, NY, US); Essequibo River, Moraballi Creek, near Bartica, alt. near sea-level, Oct. 16, 1929, *Sandwith 467* (DC, NY, S, U, US); Curassawaka, date lacking, *Schomburgk 608* (Camb., DC, FM, K, type, US, V, MBG, photograph and analytical drawings); Rupununi River, May, 1843, *Schomburgk 953* (B, BB, Camb., DC, V); Barima River, March, 1896, *Jenman 6965* (NY); upper Demerara River, Sept., 1887, *Jenman 4058* (NY, US).

Brazil: amazonas: Manãos, Oct., 1912, *Kuhlmann 2832* (B, U, US); Uypiranga prope Manãos, ad ripas fluvii Rio Negro, Dec. 22, 1923, *Kuhlmann 21863* (B, U, US).

2. **Forsteronia pilosa** (Vell.) Muell.-Arg. in Mart. Fl. Bras. **6**[1]: 99. 1860.

Echites pilosa Vell. Fl. Flum. 112. 1830; Icon. **3**: *pl. 38.* 1827.

Thyrsanthus pilosus (Vell.) A. DC. in DC. Prodr. **8**: 387. 1844; Miers, Apoc. So. Am. 106. 1878.

Thyrsanthus embelioides A. DC. loc. cit. 1844; Miers, loc. cit. 106. 1878.

Forsteronia embelioides (A. DC.) Muell.-Arg. loc. cit. 97. *pl. 50. fig. 2.* 1860.

Forsteronia meridionalis Muell.-Arg. loc. cit. 1860.

Forsteronia minutiflora Muell.-Arg. loc. cit. 99. 1860; Miers, loc. cit. 244. 1878.

Thyrsanthus meridionalis (Muell.-Arg.) Miers, loc. cit. 106. 1878.

Stems relatively slender, pilosulose when young, soon becoming glabrate and conspicuously lenticellate; leaves opposite, or rarely ternate, petiolate, narrowly oblong to oblong-lanceolate, apex acuminate, base very obscurely cordate, 5–9 cm. long, 1.2–3.0 cm. broad, membranaceous, rather inconspicuously glandular at the base of the midrib above, above glabrous or very rarely generally and minutely puberulent-papillate, beneath glabrous or minutely barbellate in the axils of the midrib, rarely generally and minutely puberulent-papillate; petioles 0.5–1.0 cm. long; inflorescence thyrsiform, terminal, infrequently both terminal and lateral, the terminal greatly surpassing, and the lateral much shorter than, the subtending leaves, bearing many small, white flowers; primary peduncle glabrous or infrequently minutely and rather irregularly puberulent-papillate, ultimate branches regularly and determinately composed, minutely puberulent-papillate, rarely pilosulose; pedicels 0.1–0.15 cm. long, minutely puberulent-papillate, rarely pilosulose; bracts lanceolate to ovate-lanceolate, 0.05-0.3 cm. long, scarious; calyx-lobes ovate, acute to acuminate, 0.08–0.15 cm. long, scarious, minutely puberulent-papillate without, the squamellae minute, numerous, indefinitely and regularly distributed, rarely evidently lacking; corolla very minutely papillate or essentially glabrous without, the tube about 0.1 cm. long, about 0.06–0.1 cm. in diameter at the base, 0.1–0.15 cm. in diameter at the orifice, villosulose within at the insertion of the stamens, the lobes oblong, 0.18–0.2 cm. long, spreading, conspicuously pilosulose within; stamen filaments about 0.05 cm. long, distinct and free, not agglutinated to the style, the anthers essentially included or the tips barely exserted, 0.07–0.09 cm. long, glabrous or essentially so; ovary ovoid, apocarpous, about 0.035 cm. long, minutely puberulent-papillate; nectaries somewhat shorter than the ovary; stigma blunt, 0.06–0.07 cm. long; follicles unknown.

Brazil: bahia: data incomplete, *Blanchet 1745* (BB, DC, MBG, photograph and analytical drawings); rio de janeiro: data incomplete, *Glaziou 4880, 15457*

(B); *Glaziou 3056* (Bx); MINAS GERAES: São João Baptista, date lacking, *Sellow s.n.* (B, MBG, photograph and analytical drawings).

The opposite or ternate phyllotaxy is apparently a valid specific criterion in no known species of *Forsteronia,* contrary to Mueller's assumption. On different specimens of *Blanchet 1745* may be found either type of phyllotaxy upon the same branch. Similar circumstances also are to be found in other species, as in *F. refracta* Muell.-Arg.

3. Forsteronia Luschnathi Muell.-Arg. in Mart. Fl. Bras. 6^1: 98. 1860.

Forsteronia acutifolia Muell.-Arg. loc. cit. 99. 1860; Miers, Apoc. So. Am. 246. 1878.

Forsteronia acutifolia Muell.-Arg. β. *pubescens* Muell.-Arg. loc. cit. 1860.

Thyrsanthus Luschnatii (Muell.-Arg.) Miers, loc. cit. 106. 1878, sphalm.

Forsteronia protensa Miers, loc. cit. 246. 1878.

Stems relatively slender, minutely puberulent to glabrate when young, eventually glabrate and conspicuously lenticellate; leaves opposite, shortly petiolate, oblong-lanceolate to broadly elliptic, apex acuminate, base obtuse to rounded, 4–8 cm. long, 1.5–4.0 cm. broad, firmly membranaceous, glandular at the base of the midrib above, glabrous or very minutely puberulent-papillate above and beneath, rarely minutely puberulent generally; petioles 0.3–0.8 cm. long; inflorescence thyrsiform, both terminal and lateral, the terminal somewhat surpassing, and the lateral much shorter than, the subtending leaves, bearing many small, white flowers; primary peduncle minutely puberulent, ultimate branches regularly and determinately composed, densely and minutely puberulent-papillate; pedicels 0.075–0.2 cm. long, densely puberulent-papillate; bracts lanceolate, 0.08–0.25 cm. long, scarious; calyx-lobes ovate-lanceolate, acute to acuminate, 0.1–0.15 cm. long, scarious, densely puberulent-papillate without, the squamellae minute, numerous, indefinitely and regularly distributed; corolla minutely papillate without, particularly toward the tips of the lobes, the tube 0.08–0.1 cm. long, about 0.075–0.09 cm. in diameter at the base

and 0.1–0.125 cm. in diameter at the orifice, minutely villosulose within at the insertion of the stamens, the lobes narrowly oblong, 0.13–0.15 cm. long, spreading, conspicuously pilosulose within; stamen filaments 0.03–0.05 cm. long, distinct and free, not agglutinated to the style, the anthers essentially included or the tips barely exserted, 0.075–0.1 cm. long, glabrous; ovary ovoid, about 0.025 cm. long, minutely hirtellous, apocarpous; nectaries somewhat shorter than the ovary; stigma 0.06–0.07 cm. long; follicles unknown.

Brazil: rio de janeiro: "Thelegraffenberg [Sebastiana]," Jan., 1833, *Luschnath s.n.* (Bx, type, MBG, photograph and analytical drawings); "Nouvelle Fribourg [Nova Friburgo]," Oct., 1842, *Claussen 84* (D); circa Rio de Janeiro, date lacking, *Schott 5976* (V); data incomplete, *Gaudichaud 976* (B, D); *Widgren s.n.* (S); *Glaziou 6818* (B).

The type specimen of *F. Luschnathi* possesses ternate phyllotaxy. All others cited, including the types of *F. acutifolia* and *F. protensa* (= *F. acutifolia* β *pubescens*) are characterized by normal, opposite foliage. As has been remarked previously, an occasional ternate specimen has been found in several species of *Forsteronia,* although in all other respects typical. Abnormalities in this respect have also been found upon the same specimen with normal, opposite foliage. The occurrence of ternate phyllotaxy has therefore been interpreted as an insignificant anomaly.

4. **Forsteronia elachista** Blake, Contr. U. S. Nat. Herb. **20**: 529. *pl. 41.* 1924.

Stems relatively slender, glabrous, conspicuously lenticellate when fully mature; leaves opposite, petiolate, obovate-oblong, apex shortly and rather abruptly acuminate, base obtuse to rounded, 6–10 cm. long, 2–5 cm. broad, membranaceous, glandular at the base of the midrib above, glabrous above, beneath barbellate in the axils of the midrib to glabrate; petioles 0.7–0.8 cm. long; inflorescence laxly thyrsiform, terminal or both terminal and lateral, the terminal greatly surpassing the subtending leaves, bearing many small, white flowers; primary peduncle minutely puberulent to glabrate, the ultimate branches regularly and determinately composed, densely pu-

berulent-papillate; pedicels 0.1–0.25 cm. long, minutely puberulent-papillate; bracts ovate or ovate-lanceolate, 0.05–0.1 cm. long, scarious; calyx-lobes ovate-deltoid, obtuse, 0.075–0.1 cm. long, scarious, densely puberulent-papillate without, the squamellae minute, numerous, regularly and indefinitely distributed; corolla densely puberulent-papillate without, the tube 0.08–0.1 cm. long, about 0.05–0.06 cm. in diameter at the base and 0.1–0.125 cm in diameter at the orifice, villosulose within at the insertion of the stamens, the lobes ovate-oblong, 0.11–0.15 cm. long, spreading, conspicuously villosulose within; stamen filaments about 0.02 cm. long, distinct and free, not agglutinated to the style, the anthers essentially included or the tips barely exserted, 0.07–0.08 cm. long, conspicuously barbellate; ovary ovoid, apocarpous, about 0.02 cm. long, minutely hirtellous; nectaries somewhat shorter than the ovary; stigma 0.075 cm. long; follicles unknown.

COLOMBIA: BOYACA: exact locality and date lacking, *Lawrance 453* (FM).

VENEZUELA: CARABOBO: Upper Guaremales, road from Puerto Cabello to San Felipe, in forest and clearings, alt. 100–500 m., July 2, 1920, *Pittier 8918* (G, US, TYPE, MBG, photograph and analytical drawings); DATA INCOMPLETE: *Linden 267* (D).

5. **Forsteronia graciloides** Woodson, spec. nov.

Suffruticosa volubilis; ramulis gracilibus glabris maturitate conspicue lenticellatis; foliis oppositis petiolatis obovatis vel obovato-oblongis apice breviter abrupteque subcaudato-acuminatis basi obtusis 5–8 cm. longis 2–4 cm. latis firme membranaceis supra glabris nervo medio basi pauciglanduligero subtus saepe irregulariter inconspicueque puberulis saepius glabratis; petiolis 0.4-0.8 cm. longis; inflorescentiis laxe thyrsiformibus et terminalibus et lateralibus folia saepius multo superantibus flores multas albidas gerentibus; pedunculis omnino minute puberulo-papillatis vel basi glabratis ultimis regulariter cymoso-compositis; pedicellis 0.1–0.2 cm. longis minute puberulo-papillatis; bracteis ovatis vel ovato-lanceolatis 0.05–0.15 cm. longis scariaceis; calycis laciniis lanceolatis vel ovato-lanceolatis apice acutis acuminatisve 0.075–0.1 cm. longis scariaceis minute puberulo-papillatis intus cum squamellis minutissimis paucis alternatis; corollae extus

dense puberulo-papillatae tubo 0.075–0.1 cm. longo basi ca. 0.05-0.075 cm. diametro faucibus ca. 0.1–0.125 cm. diametro metientibus intus prope insertionem staminum villosulis lobis late oblongis obtusis 0.1–0.11 cm. longis patulis intus conspicue pilosulis; filamentis staminum 0.01–0.02 cm. longis liberis haud agglutinatis antheris paululo exsertis 0.07–0.08 cm. longis conspicue barbellatis; ovario ovoideo apocarpo ca. 0.02 cm. longo minute papillato; nectariis ovario paululo brevioribus; stigmate 0.06–0.08 cm. longo; folliculis crassiusculis obscure articulatis falcatis 43–47 cm. longis glabris; seminibus 2.0–2.5 cm. longis como pallide aurantiaco ca. 3 cm. longo.

Stems relatively slender, glabrous, conspicuously lenticellate when fully mature; leaves opposite, petiolate, obovate to obovate-oblong, apex shortly and abruptly subcaudate-acuminate, base obtuse, 5–8 cm. long, 2–4 cm. broad, firmly membranaceous, above glabrous, glandular at the base of the midrib, beneath irregularly and inconspicuously puberulent, particularly in the axils of the midrib, frequently glabrate; petioles 0.4–0.8 cm. long; inflorescence laxly thyrsiform, both terminal and lateral, the terminal conspicuously surpassing the subtending leaves, bearing many small, white flowers; primary peduncle minutely puberulent-papillate to glabrate at the base, the ultimate branches regularly and determinately composed, densely puberulent-papillate; pedicels 0.1–0.2 cm. long, densely puberulent-papillate; bracts ovate to ovate-lanceolate, 0.05–0.15 cm. long, scarious; calyx-lobes lanceolate to ovate-lanceolate, acute to acuminate at the apex, 0.075–0.1 cm. long, scarious, densely and minutely puberulent-papillate, squamellae very minute, relatively few, in alternate groups; corolla densely puberulent-papillate without, the tube 0.075–0.1 cm. long, about 0.05–0.075 cm. in diameter at the base and 0.1–0.125 cm. in diameter at the orifice, villosulose within at the insertion of the stamens, the lobes broadly oblong, obtuse, 0.1–0.11 cm. long, spreading, conspicuously pilosulose within; stamen filaments 0.01–0.02 cm. long, distinct and separate, not agglutinated to the style, the anthers essentially included or the tips barely exserted, 0.07–0.08 cm. long, con-

spicuously barbellate; ovary ovoid, apocarpous, about 0.02 cm. long, minutely papillate; nectaries somewhat shorter than the ovary; stigma 0.06–0.08 cm. long; follicles rather stout, obscurely and rather irregularly articulated, falcate, 43–47 cm. long, glabrous; seeds 2.0–2.5 cm. long, the pale tawny coma about 3 cm. long.

PERU: LORETO: forest, San Ramon, near Yurimaguas, Nov. 4, 1929, *Williams 4547* (FM, MBG, TYPE); Yurimaguas, Oct. 24, 1929, *Williams 4011* (FM, MBG); prope Tarapoto, 1855–56, *Spruce 4493* (B, BB, C, D, G, V); Flutfreier Hochwald, Mündung d. Santiago, alt. 160 m., Oct. 28, 1924, *Tessmann 4413* (B, D); SAN MARTIN: Pongo de Cainarachi, Rio Cainarachi, tributary of Rio Huallaga, alt. 230 m., Sept.–Oct., 1932, *Klug 2761* (NY); JUNIN: La Merced im Chanchamayo-Thal, lichter Wald, alt. 1000 m., Dec., 1902, *Weberbauer 1888* (B).

This species differs from the complementary species of the north Atlantic coastal region of South America, *F. elachista* Blake, not only in the key characters, but also in such characters as the corolla-lobes, which are proportionally longer and narrower, and the ovary, which is minutely papillate, whilst conspicuously hirtellous in the latter species.

6. Forsteronia Gardneri (A. DC.) Muell.-Arg. in Mart. Fl. Bras. **6**[1]: 100. 1860.

Thyrsanthus Gardneri A. DC. in DC. Prodr. **8**: 387. 1844; Miers, Apoc. So. Am. 96. 1878.

Stems relatively slender, minutely and irregularly pilosulose when young, soon becoming glabrate and conspicuously lenticellate; leaves opposite, shortly petiolate, narrowly oblong-elliptic, apex acuminate, base rounded, 7–14 cm. long, 1.5–4.0 cm. broad, firmly membranaceous to subcoriaceous, glabrous, inconspicuously glandular at the base of the midrib above; petioles 0.3–0.6 cm. long, minutely puberulent-pilosulose; inflorescence laxly thyrsiform, terminal or both terminal and lateral, in either case conspicuously surpassing the subtending leaves, bearing many small, white flowers; primary peduncle pilosulose, ultimate branches regularly and determinately composed, puberulent-papillate to pilosulose; pedicels 0.05–0.1 cm. long, puberulent-papillate; bracts ovate-lanceolate, 0.05–0.2 cm. long, scarious; calyx-lobes ovate, acute, 0.1–0.11 cm. long,

scarious, puberulent-papillate without, the squamellae in groups of 2–4 opposite the calyx-lobes, or irregularly and indefinitely distributed; corolla sparsely and minutely pilosulose-papillate without, particularly toward the tips of the lobes, otherwise usually essentially glabrate, the tube 0.11–0.15 cm. long, about 0.08 cm. in diameter at the base and 0.15–0.175 cm. in diameter at the orifice, villosulose within at the insertion of the stamens, the lobes rather narrowly oblong, 0.15–0.2 cm. long, spreading, conspicuously pilosulose within; stamen filaments 0.03–0.05 cm. long, distinct and free, not agglutinated to the style, the anthers essentially included or only the tips barely exserted, 0.1–0.12 cm. long, glabrous; ovary ovoid, apocarpous, about 0.03 cm. long, minutely papillate; nectaries about half as long as the ovary; stigma 0.1–0.12 cm. long; follicles unknown.

BRAZIL: GOYAZ: exact locality lacking, 1842, *Gardner 3891* (B, BB, BM, Camb., D, DC, NY, V, TYPE, MBG, photograph and analytical drawings).

7. **Forsteronia affinis** Muell.-Arg. in Mart. Fl. Bras. 6[1]: 100. *pl. 30.* 1860.

Thyrsanthus affinis (Muell.-Arg.) Miers, Apoc. So. Am. 101. 1878.

Stems relatively stout, glabrous, conspicuously lenticellate when fully mature; leaves opposite, petiolate, ovate-elliptic, apex acuminate, base broadly obtuse or rounded, 8–12 cm. long, 3.0–4.5 cm. broad, rather delicately membranaceous, glandular at the base of the midrib above, glabrous, or very inconspicuously and minutely barbellate in the axils of the midrib beneath; petioles 0.8–0.9 cm. long; inflorescence thyrsiform, terminal, or both terminal and lateral, the terminal conspicuously surpassing, and the lateral somewhat shorter than, the subtending leaves, bearing many small, white flowers; primary peduncle glabrous or very minutely puberulent-papillate toward the tip, ultimate branches indefinitely congested, minutely puberulent-papillate; pedicels 0.08–0.1 cm. long, minutely puberulent-papillate; bracts lanceolate, 0.02-0.05 cm. long, scarious; calyx-lobes ovate-trigonal, acute, 0.07–0.1 cm. long, scarious, minutely papillate or very minutely puberulent-

papillate, the squamellae evidently lacking; corolla densely papillate without, the tube 0.075–0.1 cm. long, about 0.05–0.075 cm. in diameter at the base and 0.1–0.125 cm. in diameter at the orifice, minutely villosulose within at the insertion of the stamens, the lobes oblong-elliptic, 0.12–0.15 cm. long, spreading, papillate within; stamen filaments 0.02–0.03 cm. long, distinct and free, not agglutinated to the style, the anthers essentially included or the tips barely exserted, 0.06–0.08 cm. long, glabrous; ovary ovoid, apocarpous, about 0.03 cm. long, minutely puberulent; nectaries somewhat shorter than the ovary; stigma 0.07–0.08 cm. long; follicles unknown.

BRAZIL: AMAZONAS: in sylvis ad Ega, Rio Negro, date lacking, *Martius 2960* (M, TYPE, MBG, photograph and analytical drawings).

8. **Forsteronia rufa** Muell.-Arg. in Mart. Fl. Bras. **6**[1]: 100. *pl. 31. fig. 1.* 1860; K. Sch. in Engl. & Prantl, Nat. Pflanzenfam. **4**[2]: 187. 1895.

Thyrsanthus rufus (Muell.-Arg.) Miers, Apoc. So. Am. 104. 1878.

Forsteronia rufa Muell.-Arg. var. *subglabra* Malme, Arkiv f. Bot. **22A**[2]: 14. 1928.

Stems relatively stout, densely ferruginous-tomentulose when young, eventually becoming glabrate and conspicuously lenticellate when fully mature; leaves opposite, infrequently ternate, shortly petiolate, ovate-, oblong-, or obovate-elliptic, apex shortly and rather abruptly acuminate, base usually obscurely cordate, rarely broadly cuneate, 5–11 cm. long, 2.5–6.0 cm. broad, firmly membranaceous, above more or less densely ferruginous-hirtellous, particularly along the veins, frequently glabrate or essentially glabrous, inconspicuously glandular at the base of the midrib, beneath more or less densely ferruginous-tomentulose or -puberulent, particularly along the veins, rarely nearly glabrate; petioles 0.4–0.8 cm. long, the indument as upon the stem; inflorescence laxly thyrsiform, terminal, frequently lateral as well, greatly surpassing the subtending leaves, bearing many small, white flowers; primary peduncle ferruginous-tomentulose, ultimate branches minutely ferruginous-tomentulose, regularly and de-

terminately composed; pedicels 0.08–1.5 cm. long, minutely ferruginous-tomentulose; bracts lanceolate to ovate-lanceolate, 0.015–0.05 cm. long, scarious; calyx-lobes lanceolate to ovate-lanceolate, acuminate, minutely puberulent-papillate to ferruginous-hirtellous without, 0.13–0.2 cm. long, the squamellae in opposite groups of 2–5; corolla glabrous without, infrequently somewhat puberulent-papillate to minutely barbellate at the tips of the lobes, the tube 0.13–0.2 cm. long, about 0.05–0.75 cm. in diameter at the base and 0.15–0.175 cm. in diameter at the orifice, villosulose within, the lobes narrowly oblong, 0.2–0.4 cm. long, widely spreading, conspicuously pilosulose within; stamen filaments 0.06–0.1 cm. long, distinct and free, not agglutinated to the style, the anthers essentially included or the tips barely exserted, 0.1–0.15 cm. long, glabrous; ovary ovoid, apocarpous, about 0.03 cm. long, minutely ferruginous-hirtellous; nectaries slightly shorter than the ovary; stigma 0.1–0.18 cm. long; follicles relatively stout, very conspicuously and distantly moniliform, tortuous, 37–50 cm. long, glabrous; seeds 0.8–1.0 cm. long, the pale tawny coma 3.5–4.5 cm. long.

BRAZIL: MINAS GERAES: exact locality lacking, 1834, *Ackermann s.n.* (B, Bx); RIO DE JANEIRO: Organ Mts., date lacking, *Gardner 530* (Camb., D, TYPE, NY, US, V, MBG, photograph); Vargem, Organ Mts., Jan., 1838, *Miers 4049* (US); data incomplete: *Glaziou 6905* (B, Bx); *Glaziou 5939* (B, FM, US); *Glaziou 8799* (B); *Glaziou 14065* (B); SÃO PAULO: sepibus sylvestribus in Serra do Mar et versus fl. Paraiba, date lacking, *Martius s.n.* (M); sylvis Capoes udis, Jan., year lacking, *Martius s.n.* (M); Butantan, Feb. 22, 1918, *Hoehne 1512* (B); Iguape, April 25, 1918, *Hoehne 1841* (B); PARANA: Morretes, ad marginem silvae primaevae, alt. ca. 40 m., Jan. 4, 1914, *Dusen 14272* (D, US); Jacarehy, in silva primaeva, Febr. 11, 1915, *Dusen 16662* (D, US); SANTA CATHARINA: am Waldrand, Ins. São Francisco, Febr., 1885, *Ule 350* (B); Waldrand bei Itajahy, Jan., 1886, *Ule 510* (B); am Capivary bei Tubarão, Jan., 1889, *Ule 1051* (B, US); DATA INCOMPLETE: *Sellow 211* (B); *Sellow 358* (B); *Sellow 219* (B); *Sellow 543* (B); *Sellow s.n.* (B); *Riedel s.n.* (B, BB, V).

This is probably the most variable species of the genus. The dimensions of the floral parts are particularly puzzling in this regard, as well as the superficial aspect of the inflorescence as a whole. Especially noteworthy are the two specimens of *Ule 1051* from the province of Santa Catharina, which vary from the norm of the species in the cuneate bases of the leaves and a somewhat ashy tinge of the ferruginous indument.

9. **Forsteronia Acouci** (Aubl.) A. DC. in DC. Prodr. **8**: 439. 1844.

Apocynum Acouci Aubl. Hist. Pl. Gui. Fr. **1**: 274; **3**: *pl. 107.* 1775.

Apocynum paniculatum Lam. Encycl. **1**: 214. 1783.

Thyrsanthus Schomburgkii Benth. in Hook. Jour. Bot. **3**: 245. 1841; A. DC. loc. cit. 387. 1844; Miers, Apoc. So. Am. 94. 1878.

Forsteronia Schomburgkii (Benth.) Muell.-Arg. in Mart. Fl. Bras. **6**[1]: 107. 1860, not A. DC.

Thyrsanthus Acouci (Aubl.) Miers, loc. cit. 98. 1878.

Stems relatively stout, glabrous, conspicuously lenticellate when fully mature; leaves opposite, shortly petiolate, oblong- to ovate- or obovate-elliptic, apex shortly and abruptly acuminate, base broadly obtuse or rounded, 8–15 cm. long, 3–7 cm. broad, membranaceous, glabrous, inconspicuously glandular at the base of the midrib above; petioles 0.3–0.7 cm. long; inflorescence thyrsiform, both terminal and lateral, usually somewhat shorter than the subtending leaves, bearing many small, white flowers; primary peduncle minutely puberulent-papillate to glabrate, ultimate branches congested, but regularly and determinately composed, densely and minutely puberulent-papillate; pedicels 0.05-0.1 cm. long, very minutely puberulent-papillate; bracts ovate to ovate-lanceolate, 0.07–0.15 cm. long, scarious; calyx-lobes ovate to ovate-lanceolate, acute to broadly acuminate, 0.1–0.17 cm. long, scarious, densely papillate, the squamellae solitary or rarely paired, alternate; corolla minutely puberulent-papillate without, particularly toward the tips of the lobes, the tube 0.1–0.2 cm. long, about 0.05–0.1 cm. in diameter at the base and 0.175–0.2 cm. in diameter at the orifice, villosulose within at the insertion of the stamens, the lobes oblong or ovate-oblong, 0.09–0.13 cm. long, only slightly spreading, minutely papillate within; stamen filaments 0.06–0.1 cm. long, distinct and free, not agglutinated to the style, the anthers essentially included or the tips barely exserted, 0.15–0.2 cm. long, barbellate, or very minutely papillate at the tips; ovary ovoid, apocarpous, about 0.05 cm. long, minutely puber-

ulent; nectaries about equalling the ovary; stigma 0.13–0.2 cm. long; follicles unknown.

TRINIDAD: wet forest border, near Caroni River, south of Arima, April 11, 1921, *Britton & Britton 2900* (NY).

BRITISH GUIANA: data incomplete, *Schomburgk 37* (D, V); *Schomburgk 557* (B, BB, Camb., D, NY, US, V); *Schomburgk 782* (B, BB, Camb., D, V); rip. fl. Barima, Oct., 1843, *Schomburgk 1514* (B).

DUTCH GUIANA: fl. Nickerie, July, 1900, *Tulleken 90* (U); near the 2n or Oude Ryweg, Paramaribo, May 23, 1916, *Samuels 439* (B, G, NY); Paramaribo, 1850, *Wullschlägel 454* (V); fluv. Lawa, Dec., 1903, *Versteeg 415* (U); Jagtlust-Meerzog, fluv. Suriname, Jan. 8, 1924, *Collector Indigenous 8F* (B, U); DATA INCOMPLETE: *Hostmann & Kappler 569* (U); *Hostmann 569a* (BB, D, FM, S); *Hostmann 6118* (V); *Hostmann & Kappler 1236* (B, BB, D, M, S, V).

FRENCH GUIANA: data incomplete, *leBlond* [?] *379* (B, C).

Aublet's illustration of *Apocynum Acouci* leaves little doubt concerning its association with *Thyrsanthus Schomburgkii* Benth., a common plant of the Guianas. The association of *Apocynum paniculatum* Lam. with these species is less secure, and is based only in part upon Lamarck's inconclusive diagnosis, consideration being given to the previous disposition by A. de Candolle and Miers.

10. **Forsteronia Benthamiana** Muell.-Arg. in Mart. Fl. Bras. **6**[1]: 106. 1860; K. Sch. in Engl. & Prantl, Nat. Pflanzenfam. **4**[2]: 187. 1895.

Thyrsanthus Benthamiana (Muell.-Arg.) Miers, Apoc. So. Am. 95. 1878.

Stems relatively stout, glabrous, conspicuously lenticellate when fully mature; leaves opposite, shortly petiolate, oblong-elliptic to broadly oval, apex shortly and abruptly acuminate to obtuse or rounded, base broadly obtuse or rounded, 8–18 cm. long, 2.5–8.0 cm. broad, coriaceous or subcoriaceous, somewhat nitidulous above, inconspicuously glandular at the base of the midrib, glabrous throughout; petioles 0.3–0.7 cm. long; inflorescence thyrsiform, both terminal and lateral, about equalling, or the terminal greatly surpassing, the subtending leaves, bearing many small, white flowers; primary peduncle minutely puberulent-papillate to glabrate below, ultimate branches regularly and determinately composed, densely puberulent-papillate; pedicels 0.1–0.3 cm. long, densely and minutely pu-

berulent-papillate; bracts ovate to ovate-lanceolate, scarious, 0.05–0.35 cm. long; calyx-lobes ovate to ovate-lanceolate, acute to obtuse, 0.1–0.2 cm. long, scarious, minutely puberulent or puberulent-papillate without, squamellae solitary, alternate; corolla minutely and irregularly papillate to essentially glabrous without, the tube 0.15–0.3 cm. long, about 0.1–0.15 cm. in diameter at the base and 0.175–0.2 cm. in diameter at the orifice, villosulose within at the insertion of the stamens, the lobes oblong to ovate-oblong, 0.2–0.3 cm. long, spreading, very minutely and irregularly papillate to essentially glabrate within; stamen filaments 0.06–0.13 cm. long, distinct and free, not agglutinated to the style, the anthers slightly exserted, 0.15–0.2 cm. long, minutely barbellate at the tips; ovary ovoid, apocarpous, minutely puberulent-papillate, about 0.05 cm. long; nectaries much shorter than the ovary; stigma 0.1–0.18 cm. long; follicles relatively stout, rather inconspicuously undulated, subparallel to tortuous, frequently united at the tips, 21–23 cm. long, glabrous; seeds 2.0–2.3 cm. long, the bright tawny coma 1.3–2.0 cm. long.

BRAZIL: PARA: Juruty Velho, silva locis altis, July 29, 1927, *Ducke 21603* (B); Oriximina, Rio Trombetas infer., silva secundaria, Sept. 17, 1910, *Ducke 21639* (B, US); AMAZONAS: prope San Carlos, ad Rio Negro, 1853-4, *Spruce 3481* (B, BB, C, D, G, M, NY, MBG, photograph and analytical drawings); Bôa Vista, Rio Branco super., ad ripas fluminis, July, 1913, *Kuhlmann 3647* (B, U, US); Manãos, ripis paludosis rivuli sylvestris, Dec. 8, 1927, *Ducke 21612* (B); ad ripis inter Campinho et Bôa Vista, Rio Branco, Nov., 1913, *Kuhlmann 3648* (B); Teffe, ad fauces lacus, June 23, 1906, *Ducke 21766* (B, US); Manãos, ad ripis Rio Negro prope faucem flum. Taruma, April 26, 1911, *Ducke 21758* (B, US); DATA INCOMPLETE: *Glaziou 9932* (C).

PERU: LORETO: forest, Mishuyacu, near Iquitos, alt. 100 m., Febr.–March, 1930, *Klug 1053* (FM, NY, US); Stromgebiet des Maranon am Pongo de Manseriche, 1924, *Tessmann 4805* (S); Iquitos, Urwald, June 30, 1924, *Tessmann 3639* (B, D); Stromgebiet des Maranon Santiago-Mündung am Pongo de Manseriche, 1924, *Tessmann 4461* (D, S); Stromgebiet des Maranon von Iquitos, 1924, *Tessmann 5128* (B, D).

11. **Forsteronia viridescens** Blake, Contr. Gray Herb. **52**: 80. 1917.

Stems relatively stout, glabrous or essentially so, conspicuously lenticellate when fully mature; leaves opposite, shortly petiolate, oblong-elliptic, apex very shortly and abruptly acu-

minate, base broadly obtuse or rounded, 9–13 cm. long, 2.5–6.0 cm. broad, coriaceous or subcoriaceous, somewhat nitidulous above, glandular at the base of the midrib above, glabrous throughout; petioles 0.3–0.6 cm. long; inflorescence thyrsiform, terminal, rarely lateral as well, somewhat shorter than the subtending leaves, bearing many small, greenish-white flowers; primary peduncle minutely puberulent-papillate to glabrate below, ultimate branches regularly and determinately composed, minutely puberulent-papillate; pedicels 0.09–0.15 cm. long, very minutely puberulent-papillate; bracts ovate to ovate-lanceolate, scarious, 0.09–0.18 cm. long; calyx-lobes ovate, acute, 0.1–0.13 cm. long, scarious, very minutely puberulent-papillate, the squamellae minute, solitary, alternate, occasionally lacking; corolla densely and uniformly puberulent-papillate without, the tube 0.15-0.17 cm. long, about 0.075 cm. in diameter at the base and 0.175-0.2 cm. in diameter at the orifice, villosulose within, the lobes broadly oblong to ovate-oblong, 0.18–0.2 cm. long, spreading, minutely puberulent within; stamen filaments 0.05–0.08 cm. long, distinct and free, not agglutinated to the style, the anthers slightly exserted, 0.15–0.17 cm. long, minutely and sparsely barbellate at the tips; ovary ovoid, apocarpous, about 0.05 cm. long, papillate; nectaries much shorter than the ovary; stigma 0.12–0.13 cm. long; follicles unknown.

British Honduras: forest near Manatee Lagoon, July 7, 1906, *Peck 450* (G, type, MBG, photograph and analytical drawings); secondary forest, rare, Middlesex, alt. 200 ft., Sept. 20, 1929, *Schipp 360* (B, D, FM, MBG, NY).

12. Forsteronia guyanensis Muell.-Arg. Linnaea **30**: 414. 1860.

Thyrsanthus Guyanensis (Muell.-Arg.) Miers, Apoc. So. Am. 97. 1878.

Stems relatively stout, minutely puberulent when very young, soon becoming glabrate and conspicuously lenticellate when fully mature; leaves opposite, shortly petiolate, elliptic-obovate, apex very abruptly and shortly acuminate to obtuse, base obtusely cuneate, 3–9 cm. long, 1.5–3.5 cm. broad, coriaceous or subcoriaceous, rather inconspicuously glandular at the base of the midrib above, glabrous throughout; petioles

0.2–0.5 cm. long; inflorescence thyrsiform, both terminal and lateral, equalling to conspicuously surpassing the subtending leaves, bearing many small, white flowers; primary peduncle densely papillate to glabrate below, ultimate branches regularly and determinately composed, densely papillate; pedicels 0.09–0.2 cm. long, densely papillate; bracts ovate to ovate-lanceolate, scarious, 0.08–0.2 cm. long; calyx-lobes ovate, acute to acuminate, 0.1–0.14 cm. long, scarious, densely and very minutely puberulent-papillate without, the squamellae usually lacking, occasionally very minute, solitary, and alternate; corolla minutely puberulent-papillate without, the tube 0.15–0.2 cm. long, about 0.075–0.1 cm. in diameter at the base and 0.17–0.2 cm. in diameter at the orifice, minutely puberulent-papillate within near the orifice, the lobes broadly oblong to ovate-oblong, 0.15–0.22 cm. long, spreading, minutely and densely papillate or puberulent-papillate within; stamen filaments 0.07–0.1 cm. long, distinct and free, not agglutinated to the style, the anthers slightly exserted, 0.15–0.18 cm. long, glabrous; ovary ovoid, minutely puberulent, apocarpous; nectaries about equalling the ovary; stigma 0.12–0.15 cm. long; follicles very slender and tortuous, obscurely and indefinitely articulated or essentially entire, 45–50 cm. long, very densely and minutely ferruginous-papillate; seeds 1.5 cm. long, the bright tawny coma 2.8–3.2 cm. long.

British Guiana: rip. fl. Sururu, Sept., 1843, *Schomburgk 1446* (B, isotype, MBG, photograph and analytical drawings); exact locality lacking, 1844, *Schomburgk 821* (BB, Camb., D); mixed forest, Essequibo River, Moraballi Creek, near Bartica, alt. near sea-level, Oct. 9, 1929, *Sandwith 405* (NY, S, U, US); "Demarara," date lacking, *Jenman 5091* (K, NY).

Dutch Guiana: in summus monte Brownsberg, July 28, 1924, *Stahel & Gonggrijp 6624* (U); in silva pr. Voltzberg, fluv. Coppename, July–Sept., 1920, *Pulle 291* (B, U); in silva pr. Avanaverovallen, fluv. Kabalebo, July–Sept., 1920, *Pulle 453* (B, NY, U); fluv. Coppename inf., Aug., 1901, *Went 109* (U).

French Guiana: Karouany, 1858, *Sagot 1067* (BB, Bx, U); data incomplete: *leBlond* [?] *381* (B); *Martin s.n.* (B); *Poiteau s.n.* (D); *Melonon 460* (B).

Brazil: para: Peixeboi ad viam ferream Belem-Bragança, silva, Oct. 30, 1907, *Siqueira 21623* (B, U, US).

13. **Forsteronia brevifolia** Mgf. Notizblatt **10**: 1038. 1930.

Stems relatively stout, minutely papillate when very young, soon becoming glabrate and conspicuously lenticellate when

fully mature; leaves opposite, very shortly petiolate, broadly elliptic to obovate-elliptic, apex very shortly and abruptly acuminate to obtuse, base broadly obtuse or rounded, 4–7 cm. long, 2.0–3.5 cm. broad, coriaceous, somewhat nitidulous above and inconspicuously glandular at the base of the midrib, glabrous throughout; petioles 0.3–0.5 cm. long; inflorescence corymbose-thyrsiform, flat-topped or only somewhat convex, both terminal and lateral, about equalling or somewhat shorter than the subtending leaves, bearing many small, white flowers; primary peduncle very densely and minutely puberulent-papillate, ultimate branches regularly and determinately composed, densely puberulent-papillate; pedicels 0.1–0.2 cm. long, densely and minutely puberulent-papillate; bracts ovate-lanceolate, 0.03–0.075 cm. long, scarious; calyx-lobes ovate to ovate-deltoid, obtuse or rounded, 0.1–0.125 cm. long, scarious, minutely puberulent-papillate without, the squamellae minute, solitary or rarely paired, alternate, occasionally lacking; corolla rather irregularly puberulent-papillate without, the tube 0.13–0.15 cm. long, about 0.075–0.1 cm. in diameter at the base and 0.15–0.2 cm. in diameter at the orifice, villosulose within, the lobes oblong to oblong-lanceolate, 0.25–0.275 cm. long, only slightly spreading, minutely puberulent to essentially glabrous within; stamen filaments 0.03–0.05 cm. long, distinct and free, not agglutinated to the style, the anthers slightly exserted, 0.15–0.175 cm. long, glabrous; ovary ovoid, apocarpous, minutely papillate; nectaries somewhat shorter than the ovary; stigma 0.2 cm. long; follicles unknown.

BRAZIL: AMAZONAS: Tocantins, silva non inundabili, Nov. 13, 1927, *Ducke 21614* (B, TYPE, US, MBG, photograph and analytical drawings).

PERU: LORETO: forest, Mishuyacu, near Iquitos, alt. 100 m., Dec., 1929, *Klug 640* (FM, NY, US).

14. **Forsteronia Wilsonii** (Griseb.) Woodson, comb. nov.

Thyrsanthus Wilsonii Griseb. Fl. Brit. W. I. 412. 1864.

Stems relatively slender, glabrous, rather inconspicuously lenticellate when fully mature; leaves opposite, shortly petiolate, elliptic, apex rather abruptly and acutely subcaudate-acuminate, base broadly obtuse, 4–11 cm. long, 1.5–4.0 cm. broad, membranaceous, glabrous, inconspicuously glandular at

the base of the midrib above; petioles 0.2–0.5 cm. long; inflorescence thyrsiform, terminal, somewhat shorter than the subtending leaves, bearing many small, white flowers; primary peduncle minutely puberulent, ultimate branches somewhat congested, minutely puberulent to puberulent-papillate; pedicels about 0.1 cm. long, puberulent-papillate; bracts linear to linear-lanceolate, 0.1–0.4 cm. long, slightly foliaceous; calyx-lobes linear to linear-lanceolate, acuminate, 0.38–0.4 cm. long, slightly foliaceous, rather irregularly and sparsely puberulent-papillate, the squamellae very minute, numerous, regularly and indefinitely distributed; corolla irregularly and sparsely puberulent-papillate without, the tube 0.12–0.15 cm. long, about 0.07–0.08 cm. in diameter at the base and 0.15–0.175 cm. in diameter at the orifice, villosulose within, the lobes ovate-oblong, 0.2–0.25 cm. long, puberulent-papillate within, widely spreading; stamen filaments 0.05 cm. long, distinct and free, not agglutinated to the style, the anthers slightly exserted, 0.15–0.175 cm. long, glabrous; ovary ovoid, apocarpous, about 0.05 cm. long, minutely puberulent-papillate; stigma 0.12–0.15 cm. long; nectaries much shorter than the ovary; follicles unknown.

JAMAICA: on trees, Manchester, date lacking, *Wilson s.n.* (K, TYPE, NY, MEROTYPE and analytical drawings); vicinity of Mandeville, April 26–30, 1910, *Crawford 714* (NY, MBG, photograph and analytical drawings); data incomplete, *Bertero s.n.* (B).

This combination has been ascribed to Bentham & Hooker upon herbarium labels, although there appears to be no actual basis for such citation.

15. **Forsteronia diospyrifolia** Muell.-Arg. Linnaea **30**: 415. 1860.

Thyrsanthus diospyrifolius (Muell.-Arg.) Miers, Apoc. So. Am. 96. 1878.

Stems relatively stout, glabrous or minutely puberulent-papillate when very young, conspicuously lenticellate when fully mature; leaves opposite, shortly petiolate, obovate- to elliptic-oblong, apex abruptly acute to obtuse, base broadly obtuse or rounded, 7–12 cm. long, 2.5–5.0 cm. broad, heavily

coriaceous, glabrous, eglandular; petioles 0.4–0.6 cm. long; inflorescence thyrsiform, both terminal and lateral, about equalling or somewhat shorter than the subtending leaves, bearing many small, white flowers; primary peduncle minutely and rather sparsely puberulent to glabrate, ultimate branches congested, puberulent to puberulent-papillate; pedicels 0.03–0.05 cm. long, puberulent-papillate; bracts ovate, 0.05–0.35 cm. long, scarious; calyx-lobes ovate, acute to obtuse, 0.175–0.3 cm. long, scarious, rather irregularly puberulent-papillate without, the squamellae solitary, alternate, minute; corolla puberulent-papillate without, the tube 0.125–0.15 cm. long, about 0.1 cm. in diameter at the base and 0.2 cm. in diameter at the orifice, villosulose within, the lobes oblong-elliptic, 0.175–0.2 cm. long, somewhat spreading, minutely puberulent-papillate within; stamen filaments 0.08–0.1 cm. long, distinct and free, not agglutinated to the style, the anthers slightly exserted, 0.175–0.2 cm. long, glabrous or very minutely barbellate; ovary apocarpous, ovoid, about 0.075 cm. long, minutely papillate; stigma 0.15 cm. long; nectaries somewhat shorter than the ovary; follicles unknown.

BRITISH GUIANA: in savannis, Oct., 1846, *Schomburgk 854* (B, TYPE, MBG, photograph and analytical drawings); Roraima, 1842–3, *Schomburgk 725* (D).

16. **Forsteronia Riedelii** Muell.-Arg. in Mart. Fl. Bras. 6[1]: 103. 1860; Miers, Apoc. So. Am. 245. 1878.

Stems relatively stout, glabrous, conspicuously lenticellate when fully mature; leaves opposite, shortly petiolate, oblong-elliptic, apex abruptly and obtusely subcaudate-acuminate, base broadly obtuse, 5–9 cm. long, 2.5–3.5 cm. broad, firmly membranaceous, glabrous, eglandular; petioles 0.5–0.8 cm. long; inflorescence thyrsiform, both terminal and lateral, somewhat shorter than the subtending leaves, bearing many small, white flowers; primary peduncle minutely puberulent-papillate, ultimate branches regularly and determinately composed, minutely puberulent-papillate; pedicels 0.2–0.3 cm. long, minutely puberulent-papillate; bracts ovate to ovate-lanceolate, 0.08–0.15 cm. long, scarious; calyx-lobes ovate, acute, 0.1–0.12 cm. long, scarious, minutely puberulent-papil-

late, the squamellae solitary, alternate, minute; corolla minutely puberulent-papillate without, the tube 0.125–0.2 cm. long, about 0.075–0.1 cm. in diameter at the base and 0.2–0.3 cm. in diameter at the orifice, villosulose within, the lobes oblong-ovate, slightly reflexed, 0.2–0.25 cm. long, puberulent within; stamen filaments 0.05 cm. long, distinct and free, not agglutinated to the style, the anthers slightly exserted, about 0.2 cm. long, glabrous; ovary ovoid, apocarpous, about 0.075 cm. long, hirtellous; stigma 0.15–0.2 cm. long; nectaries somewhat shorter than the ovary; follicles unknown.

BRAZIL: AMAZONAS: silva non inundabili circa cataractas flum. Taruma superioris, Manãos, Oct. 17, 1929, *Ducke 22429* (B); dense forest, Manãos, alt. 25 m., Oct. 17, 1929, *Killip & Smith 30151* (MBG, NY, US).

The type specimen of this species has not been available for study. The specimens collected by Ducke and Killip & Smith from the vicinity of Manãos accord well with the original description of *F. Riedelii,* the type specimen of which, collected by Riedel, is cited as from the Serra d'Estrella. It will not be surprising, therefore, if the specimens cited from Amazonas may eventually be proved to represent a distinct species.

17. **Forsteronia Duckei** Mgf. Notizblatt **9**: 962. 1926.

Stems relatively stout, glabrous, or very minutely puberulent when young, conspicuously lenticellate when fully mature; leaves opposite, very shortly petiolate, oblong- to ovate-elliptic, apex very shortly and abruptly acuminate to obtuse, base very broadly obtuse to rounded, 9–16 cm. long, 4–5 cm. broad, firmly membranaceous, glabrous, inconspicuously glandular at the base of the midrib above; petioles 0.3–0.35 cm. long; inflorescence thyrsiform, terminal, about equalling the subtending leaves or somewhat shorter, bearing many small, white flowers; primary peduncle minutely ferruginous-puberulent, ultimate branches regularly and determinately composed, minutely and densely puberulent-papillate; pedicels 0.1–0.15 cm. long, minutely puberulent-papillate; bracts ovate, 0.01–0.025 cm. long, scarious; calyx-lobes ovate-reniform, broadly obtuse or rounded, 0.075–0.1 cm. long, scarious, densely and minutely puberulent-papillate, the squamellae very mi-

nute, solitary, alternate; corolla densely and minutely puberulent-papillate without, the tube 0.08–0.1 cm. long, about 0.075 cm. in diameter at the base and 0.125 cm. in diameter at the orifice, villosulose within, the lobes oblong-elliptic, 0.2 cm. long, essentially glabrous within; stamen filaments 0.05 cm. long, the anthers slightly exserted, about 0.125 cm. long, glabrous; ovary ovoid, minutely papillate, about 0.07 cm. long; stigma 0.2 cm. long, slightly exserted beyond the connate anthers; nectaries somewhat shorter than the ovary; follicles unknown.

BRAZIL: PARA: ad ripas fluminis Anajaz, in parte occidentali insula Marajo, Nov. 25, 1922, *Ducke 17478* (B, TYPE, US, MBG, photograph and analytical drawings).

18. **Forsteronia laurifolia** (Benth.) A. DC. in DC. Prodr. **8**: 438. 1844; Muell.-Arg. in Mart. Fl. Bras. **6**[1]: 106. 1860.

Thenardia (?) laurifolia Benth. in Hook. Jour. Bot. **3**: 246. 1841.

Thyrsanthus laurifolius (Benth.) Miers, Apoc. So. Am. 94. 1878.

Stems relatively stout, glabrous, inconspicuously lenticellate when fully mature; leaves opposite, petiolate, oblong to oblong- elliptic, apex shortly acuminate, base broadly obtuse to rounded, 6–14 cm. long, 2.5–5.0 cm. broad, coriaceous or subcoriaceous, glabrous, glandular at the base of the midrib above; petioles 0.5–1.3 cm. long; inflorescence very congested, thyrsiform, both terminal and lateral, much shorter than the subtending leaves, bearing relatively few small, white flowers; primary peduncle minutely puberulent-papillate to glabrate, ultimate branches congested, but regularly and determinately composed, minutely puberulent-papillate; pedicels 0.16–0.2 cm. long, minutely puberulent-papillate; bracts ovate, 0.08–1.4 cm. long, scarious; calyx-lobes ovate, acute to acuminate, 0.1–0.17 cm. long, scarious, very minutely and densely puberulent-papillate without, the squamellae minute, solitary, alternate, occasionally evidently lacking; corolla minutely and densely puberulent-papillate without, the tube 0.15–0.18 cm. long, about 0.1–0.125 cm. in diameter at the base and 0.175–0.2 cm. in diameter at the orifice, villosulose within, the lobes oblong-elliptic,

0.2–0.25 cm. long, puberulent-papillate within, spreading; stamen filaments 0.05–0.08 cm. long, distinct and free, not agglutinated to the style, the anthers slightly exserted, 0.16–0.2 cm. long, glabrous; ovary ovoid, apocarpous, about 0.05 cm. long, glabrous or essentially so; stigma 0.18–0.25 cm. long, somewhat exserted beyond the connate anthers; nectaries somewhat shorter than the ovary; immature follicles long and slender, continuous and more or less agglutinated, 23–30 cm. long, glabrous or essentially so; mature seed unknown.

BRITISH GUIANA: data incomplete, *Schomburgk 953* (B, BB, Camb., D, FM, K, TYPE, NY, MBG, photograph and analytical drawings).

BRAZIL: AMAZONAS: in vicinibus Barra, Jan., 1851, *Spruce 999* (B, BB, D, G, M, NY); prope Panure ad Rio Uaupes, Oct., 1852–Jan., 1853, *Spruce 2080* (B); Rio Negro pr. Joaquim, Jan., 1902, *Ule 6057* (B, D); São Joaquim, Jan., 1902, *Ule 77b* (B); ad ripas inundatas super cataractam Tapuruguara, Santa Izabel, Rio Negro, Dec. 8, 1929, *Ducke 22431* (B).

The specimens cited show this species to be unusually shrubby for the genus, and Ducke has commented upon the label of his specimen "Arbor erecta vel frutex scandens?"

19. **Forsteronia paludosa** Woodson, Ann. Mo. Bot. Gard. **21**: 620. 1934.

Stems relatively slender, glabrous, conspicuously lenticellate when fully mature; leaves opposite, very shortly petiolate, narrowly oblong-lanceolate, shortly acuminate to acute, base obtuse, 5–7 cm. long, 1.3–1.6 cm. broad, firmly membranaceous or subcoriaceous, above glabrous, inconspicuously glandular at the base of the midrib, beneath inconspicuously barbellate in the axils of the midrib, otherwise glabrous; petioles 0.25–0.3 cm. long; inflorescence compound-subspiciform, terminal, about equalling or somewhat shorter than the subtending leaves, bearing several small, white flowers; primary peduncle essentially glabrous or very irregularly and sparsely pilosulose-papillate above, ultimate branches indefinitely congested, scarcely manifest; pedicels 0.01–0.02 cm. long, very minutely puberulent-papillate; bracts minutely ovate, 0.01–0.03 cm. long, scarious; calyx-lobes ovate, acute, 0.1–0.12 cm. long, scarious, very minutely puberulent-papillate without, the squamellae evidently lacking; corolla very minutely and ir-

regularly puberulent-papillate without, the tube 0.1–0.12 cm. long, about 0.075 cm. in diameter at the base and 0.125 cm. in diameter at the orifice, minutely villosulose within, the lobes narrowly oblong, about 0.15 cm. long, densely pilosulose within; stamen filaments about 0.05 cm. long, distinct and free, not agglutinated to the style, the anthers slightly exserted, 0.15 cm. long, minutely barbellate; ovary ovoid, apocarpous, about 0.05 cm. long, minutely papillate; stigma about 0.12 cm. long; nectaries somewhat shorter than the ovary; follicles unknown.

Brazil: para: locis paludosis campos de Cupijo prope Cameta, July 22, 1916, *Ducke 21627* (B, type, US, MBG, photograph and analytical drawings).

20. **Forsteronia amblybasis** Blake, Jour. Wash. Acad. Sci. **14**: 292. 1924.

Stems relatively stout, glabrous, or very minutely and indefinitely puberulent when young, conspicuously lenticellate when fully mature; leaves opposite, petiolate, ovate to oblong-elliptic, apex rather abruptly acuminate, base broadly obtuse or rounded, 6.0–14.5 cm. long, 2.3–7.4 cm. broad, membranaceous, above glabrous, glandular at the base of the midrib, beneath glabrous or minutely ciliolate-barbellate in the axils of the midrib; petioles 0.6–1.3 cm. long; inflorescence subspiciform-paniculate, both terminal and lateral, shorter than the subtending leaves, or the terminal somewhat longer, bearing many small, greenish-white flowers; primary peduncle puberulent-papillate to glabrate below, ultimate branches indefinitely congested and scarcely manifest, puberulent-papillate; pedicels 0.08–0.1 cm. long, minutely puberulent-papillate, greatly accrescent in fruit; bracts oblong- to obovate-spathulate, 0.2–0.65 cm. long, scarious or somewhat foliaceous; calyx-lobes lanceolate to ovate-lanceolate, acuminate, 0.16–0.3 cm. long, scarious or very slightly foliaceous, minutely and rather irregularly puberulent-papillate without, the squamellae apparently lacking; corolla puberulent-papillate without, the tube 0.12–0.15 cm. long, about 0.05–0.07 cm. in diameter at the base and 0.175–0.2 cm. in diameter at the orifice, villosulose within, the lobes ovate-oblong, 0.13–0.15 cm. long, densely

pilosulose within, spreading; stamen filaments 0.03–0.05 cm. long, distinct and free, not agglutinated to the style, the anthers 0.13–0.16 cm. long, the tips slightly exserted, glabrous or occasionally minutely and sparsely barbellate; ovary ovoid, evidently syncarpous, or the carpels closely agglutinated, about 0.04 cm. long, minutely appressed-puberulent; stigma 0.11–0.12 cm. long; nectaries equalling or slightly surpassing the ovary; follicles very stout, continuous, 15–19 cm. long, glabrous; seeds 1.5–1.7 cm. long, the pale tawny coma 3.5–5.0 cm. long.

BOLIVIA: LA PAZ: Tipuani-Guani, Dec., 1892, *Bang 1689* (B, BB, MBG, NY, US, TYPE); "Songo," Nov., 1890, *Bang 850* (B, BB, FM, M, MBG, NY, US); Polo-Polo, bei Coroico, alt. 1100 m., Oct.–Nov., 1912, *Buchtien 3953* (NY); SANTA CRUZ: bosque, Buena Vista, Prov. Sara, alt. 400 m., Dec. 3, 1924, *Steinbach 6717* (B, D, FM, MBG, NY, US); feuchter Wald, Buena Vista, alt. 450 m., May 5, 1928, *Steinbach 8020* (B, NY).

21. **Forsteronia decipiens** Woodson, spec. nov.

Fruticosa volubilis; ramulis crassiusculis glabris maturitate conspicue lenticellatis; foliis oppositis petiolatis ovato- vel oblongo-ellipticis apice abrupte breviterque subcaudato-acuminatis basi late obtusis rotundatisve rarius obscurissime cordatis 7.5–13.0 cm. longis 2.8–8.0 cm. latis firme membranaceis supra paululo nitidulis nervo medio basi pauciglanduligero caeterumque glabris subtus opacis glabris vel inconspicuissime barbellatis; petiolis 0.6–1.1 cm. longis glabris; inflorescentiis anguste irregulariterque subspiciformi-thyrsoideis et terminalibus et lateralibus foliis paululo brevioribus flores multas parvas albidas gerentibus; pedunculo irregulariter sparseque puberulo vel glabrato; pedicellis 0.1–0.12 cm. longis post maturitatem conspicue accrescentibus minute puberulo-papillatis; bracteis 0.1–0.5 cm. longis minute puberulo-papillatis subfoliaceis maioribus oblongo- vel obovato- spathulatis minoribus pedicellos subtendentibus anguste lanceolatis; calycis laciniis ovato-ellipticis acutis 0.18–0.25 cm. longis subfoliaceis minute puberulo-papillatis squamellis non visis; corollae albidae extus minute papillatae tubo campanulato 0.1–0.12 cm. longo basi ca. 0.05 cm. diametro metiente faucibus ca. 0.15 cm. diametro metientibus intus villosulo lobis ovato-

oblongis 0.18–0.2 cm. longis intus dense villosulis patulis; filamentis staminum 0.04–0.05 cm. longis stylum haud agglutinatis antheris 0.13–0.15 cm. longis apice paulo exsertis sparse barbellatis rariusve glabratis; ovario ovoideo ut videtur syncarpo vel carpellis inter se agglutinatis ca. 0.04 cm. longo minute puberulo; nectariis ovarium aequantibus vel paululo superantibus; folliculis crassiusculis rigidis continuis divaricatis 10–13 cm. longis glabris; seminibus 1.6–1.7 cm. longis como dilute aurantiaco 4.0–4.5 cm. longo.

Stems relatively stout, glabrous, conspicuously lenticellate at maturity; leaves opposite, petiolate, ovate- to oblong-elliptic, apex abruptly and shortly subcaudate-acuminate, base broadly obtuse to rounded, rarely obscurely cordate, 7.5–13.0 cm. long, 2.8–8.0 cm. broad, firmly membranaceous, above slightly nitidulous, glandular at the base of the midrib, otherwise glabrous, beneath opaque, glabrous or very inconspicuously barbellate in the axils of the midrib; petiole 0.6–1.1 cm. long, glabrous; inflorescence narrowly and rather irregularly subspiciform-thyrsiform, both terminal and lateral, somewhat shorter than the subtending leaves, occasionally conspicuously longer when terminal, bearing many small, white flowers; peduncle irregularly and sparsely puberulent to glabrate; pedicels 0.1–0.12 cm. long, conspicuously accrescent in fruit, minutely puberulent-papillate; bracts 0.1–0.5 cm. long, more or less subfoliaceous, minutely puberulent-papillate, the larger oblong- to obovate-spathulate, the smaller which immediately subtend the pedicels narrowly lanceolate; calyx-lobes ovate-elliptic, acute, 0.18–0.25 cm. long, subfoliaceous, minutely puberulent-papillate, squamellae not seen; corolla whitish, minutely papillate without, the tube campanulate, 0.1–0.12 cm. long, about 0.05 cm. in diameter at the base and about 0.15 cm. in diameter at the orifice, villosulose within, the lobes ovate-oblong, 0.18–0.2 cm. long, densely villosulose within, spreading; stamen filaments 0.04–0.05 cm. long, distinct and free, not agglutinated to the style, the anthers 0.13–0.15 cm. long, slightly exserted at the tips, sparsely barbellate to glabrate; ovary ovoid, evidently syncarpous or the carpels agglutinated, about 0.04 cm. long, minutely puberulent; nectaries about equalling

or slightly surpassing the ovary; follicles relatively stout and rigid, sharply divaricate, 10–13 cm. long, glabrous; seeds 1.6–1.7 cm. long, the pale tawny coma 4.0–4.5 cm. long.

PERU: LORETO: forest, Balsapuerto, alt. 220 m., Febr., 1933, *Klug 2905* (NY, TYPE, MBG, photograph); same locality, June, 1933, *Klug 3104* (NY, fruiting co-TYPE, MBG, photograph); SAN MARTIN: sandy soil, Tarapoto, alt. 360–900 m., Dec. 13, 1929, *Williams 6156* (FM, MBG, US).

Although this species is very closely related to the preceding, for which it was mistaken for some time by the writer, the size and composition of the bracts render the inflorescence quickly and accurately distinguishable. Both *F. decipiens* and *F. amblybasis* have long passed for the less frequent *F. montana* Muell.-Arg. of eastern Brazil.

22. **Forsteronia montana** Muell.-Arg. in Mart. Fl. Bras. 6^1: 101. 1860; Miers, Apoc. So. Am. 245. 1878.

Forsteronia Sellowii Muell.-Arg. loc. cit. 1860; Miers, loc. cit. 1878.

Stems relatively stout, glabrous, conspicuously lenticellate when fully mature; leaves opposite, petiolate, elliptic-lanceolate to oval-obovate, apex acuminate, base broadly obtuse to rounded, firmly membranaceous, above glabrous, glandular at the base of the midrib, beneath glabrous or inconspicuously barbellate in the axils of the midrib, 3.5–10.6 cm. long, 1.1–5.4 cm. broad; petioles 0.5–1.2 cm. long; inflorescence thyrsiform, terminal, or lateral as well, about equalling or somewhat surpassing the subtending leaves, occasionally shorter, particularly when lateral, bearing many small, white flowers; primary peduncle minutely puberulent to glabrate below, ultimate branches indefinitely congested and scarcely manifest, minutely puberulent to puberulent-papillate; pedicels 0.07–0.15 cm. long, puberulent-papillate; bracts ovate-lanceolate to linear, scarious, 0.05–0.1 cm. long; calyx-lobes ovate, acute to acuminate, 0.11–0.18 cm. long, scarious, puberulent-papillate without, the squamellae evidently lacking; corolla puberulent-papillate without toward the lobes, the tube 0.11–0.13 cm. long, about 0.04–0.07 cm. in diameter at the base and 0.12–0.14 cm. in diameter at the orifice, minutely villosulose within, the lobes

ovate-oblong, 0.17–0.2 cm. long, slightly spreading, minutely pilosulose within; stamen filaments 0.05–0.07 cm. long, distinct and free, not agglutinated to the style, the anthers 0.16–0.18 cm. long, the tips minutely barbellate, slightly exserted; ovary ovoid, syncarpous or agglutinated, minutely puberulent to hirtellous; stigma 0.12–0.14 cm. long; nectaries somewhat shorter than the ovary; follicles relatively stout and rigid, continuous, 22–28 cm. long, glabrous; seeds unknown, the pale tawny coma 5–6 cm. long.

BRAZIL: RIO DE JANEIRO: silvis caeduis, Sebastianopolis, date lacking, *Martius 183* (M); data incomplete, *Glaziou 7532* (B); DATA INCOMPLETE: *Sellow s.n.* (Bx, ISOTYPE, NY, MBG, photograph and analytical drawings); *Sellow 396* (B); *Riedel s.n.* (BB).

23. **Forsteronia pubescens** A. DC. in DC. Prodr. **8**: 436. 1844; Muell.-Arg. in Mart. Fl. Bras. **6**[1]: 104. 1860; K. Sch. in Engl. & Prantl, Nat. Pflanzenfam. **4**[2]: 187. 1895.

Thyrsanthus pubescens (A. DC.) Miers, Apoc. So. Am. 101. 1878.

Thyrsanthus placidus Miers, loc. cit. 1878.

Stems relatively stout, hirtellous when young, eventually becoming glabrate and conspicuously lenticellate when fully mature; leaves opposite, petiolate, broadly oval to narrowly oblong-elliptic, apex obtuse to acuminate, base obtuse to acutish, 3.0–12.5 cm. long, 1.5–7.5 cm. broad, membranaceous, above generally puberulent to glabrate, rarely essentially glabrous, inconspicuously glandular at the base of the midrib, beneath softly and generally puberulent; petioles 0.4–0.8 cm. long, densely puberulent; inflorescence rather narrowly thyrsiform, terminal, usually equalling or somewhat surpassing the subtending leaves, less frequently shorter, bearing many small, white flowers; primary peduncle puberulent as upon the stem, ultimate branches regularly determinate, minutely puberulent; pedicels 0.1–0.2 cm. long, minutely puberulent; bracts ovate to lanceolate, 0.075–0.6 cm. long, slightly foliaceous to scarious; calyx-lobes ovate to ovate-lanceolate, acute to acuminate, 0.11–0.2 cm. long, scarious, rather inconspicuously puberulent-papillate without, the squamellae 5–6 times as numerous as the lobes, narrowly linear, indefinitely and regularly distributed; corolla

essentially glabrous without, the tube 0.07–0.12 cm. long, about 0.05–0.1 cm. in diameter at the base and 0.1–0.18 cm. in diameter at the orifice, densely villosulose within, the lobes narrowly oblong, 0.3–0.5 cm. long, widely spreading, pilosulose within; stamen filaments 0.2–0.3 cm. long, connate and agglutinated to the style, the anthers 0.2–0.25 cm. long, glabrous, wholly exserted; ovary ovoid, apocarpous, minutely puberulent-papillate, about 0.05 cm. long; stigma and style 0.11–0.17 cm. long; nectaries about equalling, or slightly shorter than the ovary; follicles rather stoutish, very obscurely undulate-articulated, usually more or less falcate, 11–27 cm. long, glabrous; seeds 0.9–1.2 cm. long, the bright tawny coma 2.5–3.5 cm. long.

BRAZIL: CEARA: data incomplete, 1837–41, *Gardner 1761* (BB, TYPE, Bx, Camb., D, NY, US, MBG, photograph and analytical drawings); BAHIA: Jacobina, date lacking, *Blanchet 2652* (B, Bx, D, NY); Catingas, date lacking, *Blanchet 2452* (D); Rio Preto, date lacking, *Pohl 2189* (V); in campis ad Caitete, Nov., year lacking *Martius s.n.* (V); MINAS GERAES: data incomplete, *Claussen s.n.* (D); RIO DE JANEIRO: data incomplete, *Glaziou 12939* (B, D); MATTO GROSSO: Santa Anna da Chapada, Oct. 13, 1902, *Malme 2489* (D, S, US).

BOLIVIA: BENI: junction of rivers Beni and Madre de Dios, Aug., 1886, *Rusby 2526* (B, BB, FM, MBG, NY, US); SANTA CRUZ: bosque del Rio Cuchi, Prov. Sara, alt. 500 m., Aug. 16, 1925, *Steinbach 7782* (B, D, FM, MBG, U); Urubu, Prov. Cercado, alt. 450 m., Oct. 28, 1925, *Steinbach 7295* (B, D, FM, MBG, NY, U).

PARAGUAY: in regione collium "Cerros de Tobaty," Sept., 1900, *Hassler 6362* (B, BB); in regione lacus Ypacaray, Aug., 1913, *Hassler 12229* (B, BB, D, US); in dumetis pr. Ita, Sept., 1885–95, *Hassler 1038* (BB); in altaplanitie et declivibus "Serra de Amambay," Oct., 1907, *Rojas 9698* (B); Villarica, Oct., 1929, *Jørgensen 3444* (FM, MBG, NY, US); Concepcion de Paraguay, Sept., 1892, *Kuntze s.n.* (B, NY); Colonia Risso pr. Rio Apa, Oct. 4, 1893, *Malme 1038* (B, S); zwischen Rio Apa und Rio Aquidaban, San Luis, March, year lacking, *Fiebrig 5162* (B); bewaldetes Tal, Cordillera de Altos, Oct. 11, 1902, *Fiebrig 218a* (B); dans les bois, Villa-Rica, Oct. 21, 1874, *Balansa 1371* (BB, Bx, D); dans les haies, l'Assomption, June, 1874–Oct. 25, 1875, *Balansa 1371a* (B, BB, Bx); data incomplete, *Morong 810* (BB, FM, MBG, NY, US).

ARGENTINA: JUJUY: San Lorenzo, Oct. 31–Nov. 3, 1873, *Lorentz & Hieronymus 216* (B, NY, US); entre Ledesma y San Antonio, Oct. 30, 1873, *Lorentz & Hieronymus 358* (B, D); SALTA: en bosque alto, Abra Grande, Dept. Oran, alt. 750 m., Nov. 10, 1927, *Venturi 5518* (FM, MBG, US).

It appears probable that in Paraguay and northern Argentina hybridization may occur between this species and *F. glabrescens* Muell.-Arg., also a very frequent liana of forests and wooded areas. *Fiebrig 5162* is indicative of this supposition, the anthers being about the size of those of the latter species,

and conspicuously smaller than those of the former. The number and shape of the squamellae and the obtuse tips of the calyx-lobes are also very suggestive of *F. glabrescens.* On the other hand, the texture and pubescence of the foliage, as well as the size, conform with those of *F. pubescens.* The anthers of the specimens collected by Lorentz and Hieronymus, as well as the tips of the calyx-lobes, are also similar to those of *F. glabrescens,* and the indument of the lower surface of the leaves, which allies them with *F. pubescens,* is unusually scant and somewhat more conspicuous in the axils of the midrib. A more significant difference is found in the follicles, fortunately present upon several of these specimens, which are somewhat stouter than those typical of *F. glabrescens,* but more slender than those of *F. pubescens* and with conspicuous articulations suggestive of the moniliform fruits of the former species. The suggestion presents itself that more intimate study, particularly in the field, may disclose that an intermediate species exists, probably evolved through hybridization.

24. **Forsteronia cordata** (Muell.-Arg.) Woodson, comb. nov.
Forsteronia pubescens A. DC. β. *cordata* Muell.-Arg. in Mart. Fl. Bras. **6**[1]: 104. 1860.

Stems relatively stout, minutely tomentulose when young, eventually becoming glabrate and conspicuously lenticellate when fully mature; leaves opposite, very shortly petiolate, oblong-elliptic to oval, apex very shortly and abruptly acuminate to rounded, base rounded to obscurely cordate, 2.5–7.0 cm. long, 1.5–4.0 cm. broad, firmly membranaceous, above minutely and rather sparsely pilosulose-strigillose, inconspicuously glandular at the base of the midrib, beneath densely tomentulose; petioles 0.2–0.4 cm. long, minutely tomentulose; inflorescence broadly subcorymbose-thyrsiform, terminal, infrequently lateral as well, about equalling or somewhat shorter than the subtending leaves, bearing many small, yellowish (dark yellowish-red in desiccation) flowers; primary peduncle minutely puberulent to tomentulose, ultimate branches regularly and determinately composed, minutely puberulent; pedicels 0.2–0.4 cm. long, minutely puberulent; bracts lanceolate,

0.08–0.25 cm. long, only slightly foliaceous; calyx-lobes ovate, acute to acuminate, 0.1–0.15 cm. long, scarious, minutely and rather irregularly puberulent, the squamellae about 3–4 times as many as the lobes, regularly and indefinitely distributed; corolla conspicuously puberulent-papillate without at the tips of the lobes, otherwise essentially glabrous to very minutely and indefinitely papillate, the tube 0.07–0.1 cm. long, about 0.05 cm. in diameter at the base and 0.13–0.17 cm. in diameter at the orifice, densely villosulose within, the lobes oblong-lingulate, 0.35–0.43 cm. long, essentially glabrous or very minutely and indefinitely papillate within, widely spreading; stamen filaments 0.3–0.32 cm. long, connate and agglutinated to the style, the anthers wholly exserted, 0.25–0.27 cm. long, glabrous; ovary ovoid, about 0.05 cm. long, minutely puberulent to puberulent-papillate, apocarpous; stigma 0.1–0.125 cm. long, the style 0.25–0.27 cm. long; nectaries somewhat shorter than the ovary; follicles relatively slender, rather obscurely articulated, more or less falcate, 18–25 cm. long, glabrous; seeds 1.3–1.5 cm. long, the pale tawny coma 2.0–2.5 cm. long.

BRAZIL: RIO DE JANEIRO: in collibus inter frutices margine locis arenosis pr. R. Jan., Nov., 1829, *Lhotzky 29* (B, TYPE, MBG, photograph and analytical drawings); in der Restinga bei Copacabana, Nov., 1896, *Ule 4288* (B); same locality, May, 1897, *Ule 4434* (B); data incomplete, *Glaziou 14064* (B, FM); *Constantino 8675* (B, U, US); DATA INCOMPLETE: *Riedel s.n.* (B, BB, COTYPE); *Regel* (Camb.).

It appears reasonable to allow these plants specific rank, since they exhibit several important and conspicuous morphological differences distinguishing them from true *F. pubescens.* There is furthermore no evidence of any degree of intergradation between *F. cordata* and the former species.

25. **Forsteronia mollis** Rusby, Mem. Torrey Bot. Club **4**: 218. 1895.

Stem relatively stout, puberulent when young to glabrate or glabrous, conspicuously lenticellate when fully mature; leaves opposite, petiolate, oblong-elliptic to broadly oval, apex shortly and abruptly acuminate, base broadly obtuse or rounded, 7–12 cm. long, 4.0–7.5 cm. broad, membranaceous, glandular at the base of the midrib above; petioles 0.7–0.9 cm. long; inflores-

cence thyrsiform, terminal, about equalling or somewhat shorter than the subtending leaves, bearing many small, white or greenish flowers; primary peduncle puberulent to glabrate below, ultimate branches determinately composed, densely puberulent; pedicels 0.05–0.15 cm. long, minutely and densely puberulent; bracts lanceolate to ovate-lanceolate, 0.08–0.2 cm. long, only slightly foliaceous; calyx-lobes broadly ovate-suborbicular, broadly obtuse or rounded, 0.1–0.125 cm. long, scarious, minutely and densely puberulent-papillate without, the squamellae 3–5 times as many as the lobes, regularly and indefinitely distributed; corolla essentially glabrous without, the tube 0.08–0.1 cm. long, about 0.07 cm. in diameter at the base and 0.15 cm. in diameter at the orifice, villosulose within, the lobes 0.32–0.4 cm. long, minutely puberulent-papillate to essentially glabrate within, widely spreading; stamen filaments 0.15–0.22 cm. long, more or less connate and agglutinated to the style, the anthers 0.25 cm. long, wholly exserted, glabrous; ovary apocarpous, oblong-ovoid, minutely puberulent; stigma 0.12–0.15 cm. long, the style 0.15–0.175 cm. long; nectaries somewhat shorter than the ovary; follicles unknown.

Var. **typica.**

Stem puberulent when young, eventually becoming glabrate; leaves rather sparsely puberulent above, minutely tomentulose beneath; all other essential characters as in the species.

BOLIVIA: LA PAZ: "Yungas," 1890, *Bang 274* (B, BB, FM, MBG, NY, TYPE, US).

Var. **foliosa** (Rusby) Woodson, comb. nov.

Forsteronia foliosa Rusby, Descr. So. Am. Pl. 90. 1920.

Stem and leaves glabrous; all other essential characters as in the species.

BOLIVIA: LA PAZ: Polo-Polo bei Coroico, Nordyungas, alt. 1100 m., Oct.–Nov., 1912, *Buchtien 3876* (B, NY, TYPE, US, MBG, photograph and analytical drawings); same data, *Buchtien 3677* (US).

This combination is made with some trepidation, for although the presence and lack of a vegetative indument is striking in these two varieties, the general aspect of the specimens is conspicuously similar. They certainly should not be

interpreted as species upon the slight basis of available specimens.

26. **Forsteronia subcordata** K. Sch. in herb.

Fruticosa volubilis; ramulis crassiusculis glabris vel juventate minutissime papillatis maturitate conspicue lenticellatis; foliis oppositis breviter petiolatis oblongo-ellipticis apice acuminatis basi obscure cordatis 5.5–11.0 cm. longis 2.5–4.2 cm. latis tenuiter membranaceis glaberrimis nervo medio supra basi pauciglanduligero; petiolis 0.3–0.45 cm. longis; inflorescentiis thyrsiformibus terminalibus foliis conspicue brevioribus flores multas albas gerentibus; pedunculo puberulo-papillato; pedicellis 0.1–0.2 cm. longis minute puberulo-papillatis; bracteis ovatis 0.05–0.2 cm. longis scariaceis; calycis laciniis ovatis acutis acuminatisve 0.1–0.17 cm. longis scariaceis extus minute puberulo-papillatis squamellis minutissimis plus minusve numerosis regulariter positis; corollae extus glabrae vel indistinctissime papillatae tubo 0.07–0.1 cm. longo basi ca. 0.05–0.07 cm. diametro metiente faucibus ca. 0.1–0.15 cm. diametro metientibus intus minute villosulo lobis 0.3–0.4 cm. longis patulis prope apicem minute puberulo-papillatis; filamentis staminum 0.15–0.17 cm. longis stylum agglutinatis antheris 0.18–0.2 cm. longis exsertis glabris; ovario ovoideo apocarpo ca. 0.04 cm. longo minute papillato; stigmate 0.11–0.15 cm. longo; stylo ca. 0.12–0.17 cm. longo; nectariis ovarium subaequantibus; folliculis ignotis.

Stems relatively stout, glabrous or very minutely papillate when young, becoming conspicuously lenticellate when fully mature; leaves opposite, shortly petiolate, oblong-elliptic, apex acuminate, base obscurely cordate, 5.5–11.0 cm. long, 2.5–4.2 cm. broad, delicately membranaceous, glabrous, inconspicuously glandular at the base of the midrib above; petioles 0.3–0.45 cm. long; inflorescence thyrsiform, terminal, conspicuously shorter than the subtending leaves, bearing numerous small, white flowers; primary peduncle very minutely puberulent, ultimate branches determinately composed, puberulent-papillate; pedicels 0.1–0.2 cm. long, minutely puberulent-papillate; bracts ovate, 0.05–0.2 cm. long, scarious; calyx-lobes

ovate, acute to acuminate, 0.1–0.17 cm. long, scarious, minutely puberulent-papillate without, the squamellae very minute, numerous, indefinitely and regularly distributed; corolla essentially glabrous or very indefinitely papillate without, the tube 0.07–0.1 cm. long, about 0.05–0.07 cm. in diameter at the base and 0.1–0.15 cm. in diameter at the orifice, villosulose within, the lobes oblong-lingular, 0.3–0.4 cm. long, widely spreading, minutely puberulent-papillate toward the tip within; stamen filaments 0.15–0.17 cm. long, connate and agglutinated to the style, the anthers 0.18–0.2 cm. long, exserted, glabrous; ovary ovoid, apocarpous, about 0.04 cm. long, minutely papillate; stigma 0.11–0.15 cm. long, the style 0.12–0.17 cm. long; nectaries about equalling the ovary; follicles unknown.

Ecuador: manabi: in sylvestrib. ad El Recreo, Febr. 13, 1897, *Eggers 15618* (B, type, FM, M, MBG, NY).

27. **Forsteronia leptocarpa** (Hook. & Arn.) A. DC. in DC. Prodr. **8**: 438. 1844.

Parsonsia leptocarpa Hook. & Arn. in Hook. Jour Bot. **1**: 287. 1834.

Forsteronia brasiliensis A. DC. loc. cit. 436. 1844; Muell.-Arg. in Mart. Fl. Bras. **6**[1]: 102. 1860; K. Sch. in Engl. & Prantl, Nat. Pflanzenfam. **4**[2]: 187. 1895.

Forsteronia brasiliensis A. DC. β. *bahiensis* Muell.-Arg. loc. cit. 1860.

Thyrsanthus Brasiliensis (A. DC.) Miers, Apoc. So. Am. 103. 1878.

Laseguea leptocarpa (Hook. & Arn.) Miers, loc. cit. 254. 1878.

Thyrsanthus leptocarpus (Hook. & Arn.) Griseb. Gött. Abh. **24**: 224. 1879.

Forsteronia leptocarpa (Hook. & Arn.) A. DC. var. *glaberrima* Niederl. Bol. Mens. Prodr. Argent. **3**[1]: 315. 1890, nom. nud.

Stems relatively stout, more or less puberulent or pilosulose when young, soon becoming glabrate and conspicuously lenticellate when fully mature; leaves opposite, shortly petiolate,

oblong-elliptic to broadly oval, apex rather shortly and abruptly acuminate to obtuse, base obtuse to rounded, 2.0–10.5 cm. long, 1.3–5.5 cm. broad, firmly membranaceous, above glabrous, glandular at the base of the midrib, beneath minutely barbellate in the axils of the midrib; petioles 0.2–0.7 cm. long, minutely puberulent-papillate to glabrous; inflorescence thyrsiform, terminal, shorter than the subtending leaves, bearing numerous, congested, small, white flowers; primary peduncle more or less minutely puberulent to glabrate below, ultimate branches determinately composed, puberulent to puberulent-papillate; pedicels 0.07–0.125 cm. long, puberulent-papillate; bracts ovate, 0.07–0.2 cm. long, scarious; calyx-lobes ovate, acute to acuminate, 0.11–0.2 cm. long, scarious, puberulent-papillate without, the squamellae 3–5 times as many as the lobes, indefinitely and regularly distributed; corolla essentially glabrous without, the tube 0.1–0.17 cm. long, about 0.07–0.1 cm. in diameter at the base and 0.1–0.2 cm. in diameter at the orifice, villosulose within, the lobes 0.25–0.32 cm. long, villosulose at the base within, otherwise essentially glabrous to indefinitely and minutely papillate, widely spreading; stamen filaments 0.11–0.2 cm. long, connate and agglutinated to the style, the anthers 0.17–0.25 cm. long, exserted, glabrous; ovary apocarpous, ovoid, about 0.05 cm. long, minutely papillate; stigma 0.15–0.2 cm. long; style 0.08–0.15 cm. long; nectaries somewhat shorter than the ovary; follicles relatively slender, rather obscurely articulated, usually somewhat tortuous, 16–34 cm. long, glabrous; seeds 0.8–1.3 cm. long, the tawny coma 3.5–4.0 cm. long.

BRAZIL: PERNAMBUCO: Flussufer, Tapera, 1926, *Pickel 1222* (B); data incomplete, *Gardner 1059* (BM, Camb., FM, S, US, V); *Schornbaum s.n.* (Bx); BAHIA: Jacobina, date lacking, *Blanchet 3229* (BB, D, DC); Vittoria, date lacking, *Sellow 1542* (B); Sta. Anna, May, 1850, *Blanchet 3431* (BB, DC); MINAS GERAES: data incomplete, *Glaziou 14063* (D); RIO DE JANEIRO: Corvocado, date lacking, *Pohl s.n.* (Bx, V); Lagôa de Itapemerim, Dec. 9, 1915, *Frazão 7147* (B, S, U, US); ad urbem in silvis inter Gavea et Vista Chineza, Jan. 15, 1929, *Ducke 21810* (B, U); in der Restinga de Gavea, Sept., 1899, *Ule 4845* (B); bei Porto das Caixas, Dec., 1897, *Ule 4578* (B); Ypanema, in silva sat aperta, Oct. 10, 1904, *Dusen 5097* (D, S, US); Copacabana, Jan. 25, 1887, *Schenck 2269* (B); Morro do Quitambo, Jan. 4, 1887, *Schenck 1875* (B); data incomplete: *Guillemin 168* (DC); *Gaudichaud 534* (DC); *Lhotzky 74* (B); *Andersson s.n.* (S); *Glaziou 2507* (Bx);

Glaziou 4206 (B); SÃO PAULO: Barra do Juquia, Oct. 14, 1894, *Hoehne 11148* (B); Santos, Jan. 15, 1875, *Mosen 3434* (C, S); PARANA: Rio Cubatão, in silva fluminali, Dec. 28, 1911, *Dusen 13652* (S); Jacarehy, in silva primaeva reg. lit., March 22, 1914, *Dusen 14632* (FM, MBG, NY, S); SANTA CATHARINA: Gebüsch bei Tubarão, Dec., 1889, *Ule 1543* (B); data incomplete, *Pabst 557* (B); RIO GRANDE DO SUL: Porto Alegre, Dec., 1898, *Reineck & Czermak 467* (B); data incomplete, *Tweedie s.n.* (K, TYPE, MBG, photograph); DATA INCOMPLETE: *Riedel s.n.* (B, BB, D, FM, M, NY, U); *Vidensis s.n.* (Bx); *Glaziou 2507* (C); *Sellow 388* (B, Bx).

Also reported by Mueller from the State of Espirito Santa. *F. leptocarpa* is one of the most characteristic and uniform species of the genus *Forsteronia,* particularly in view of its wide distribution.

28. **Forsteronia australis** Muell.-Arg. in Mart. Fl. Bras. 6[1]: 103. 1860; Miers, Apoc. So. Am. 246. 1878.

Thyrsanthus crebriflorus Miers, loc. cit. 105. 1878.

Stems relatively stout, glabrous or minutely and indefinitely papillate when very young, becoming conspicuously lenticellate when fully mature; leaves opposite, petiolate, elliptic, apex rather abruptly acuminate, base obtuse, 3.5–10.0 cm. long, 2.0–5.5 cm. broad, firmly membranaceous, either surface glabrous, inconspicuously glandular at the base of the midrib above; petioles 0.25–0.7 cm. long, glabrous; inflorescence thyrsiform, terminal, nearly equalling or slightly surpassing the subtending leaves, bearing many small, white flowers; primary peduncle more or less densely puberulent, ultimate branches determinately composed, puberulent-papillate; pedicels 0.05–0.1 cm. long, puberulent-papillate; bracts ovate to linear, 0.07–0.2 cm. long, scarious or only slightly foliaceous; calyx-lobes ovate-deltoid, obtuse or rounded, 0.08–0.12 cm. long, scarious, densely puberulent-papillate without, the squamellae 3–5 times as many as the lobes; corolla glabrous without, the tube 0.07–0.1 cm. long, about 0.07 cm. in diameter at the base and 0.12–0.15 cm. in diameter at the orifice, minutely villosulose within at the throat, the lobes oblong-elliptic, 0.3–0.35 cm. long, rather irregularly puberulent within, widely spreading; stamen filaments 0.18–0.2 cm. long, connate and agglutinated to the style, the anthers wholly exserted, 0.22–0.25 cm. long, glabrous; ovary ovoid, apocarpous, about 0.04 cm. long, puberulent-papil-

late; stigma 0.15–0.17 cm. long; style 0.1–0.2 cm. long; nectaries about equalling the ovary; follicles unknown.

BRAZIL: BAHIA: S. Thomé, 1857, *Blanchet 3757* (Bx, DC); Igreja Velha, 1841, *Blanchet 3431* (B, DC, NY); MINAS GERAES: banks of the Rio Parahyba, 1842, *Gardner 5013* (B, BM, Camb., NY, US); GOYAZ: Ponte Alta, au Chapadão do Gama, date lacking, *Glaziou 21724* (B, S); DATA INCOMPLETE: *Sellow 460* (S).

Differing from the closely related *F. leptocarpa* not only in the key characters but in the larger inflorescence and absolutely glabrous leaves.

29. **Forsteronia obtusiloba** Muell.-Arg. Linnaea **30**: 413. 1860; Miers, Apoc. So. Am. 246. 1878.

Stems relatively stout, glabrous, conspicuously lenticellate when fully mature; leaves opposite, petiolate, ovate- to oblong-elliptic, apex acuminate, base broadly obtuse or rounded, 4.5–8.0 cm. long, 2–4 cm. broad, membranaceous, glabrous, inconspicuously glandular at the base of the midrib above; petioles 0.4–0.6 cm. long, glabrous; inflorescence rather laxly thyrsiform, terminal, about equalling the subtending leaves, bearing many small, white flowers; primary peduncle glabrate or very indefinitely papillate, ultimate branches determinate, puberulent-papillate; pedicels 0.1–0.15 cm. long, very minutely puberulent-papillate; bracts ovate, 0.07–0.12 cm. long, scarious; calyx-lobes ovate-deltoid, broadly obtuse or rounded, 0.08–0.1 cm. long, scarious, minutely papillate or puberulent-papillate without, the squamellae 3–5 times as many as the lobes; corolla essentially glabrous without, the tube 0.07–0.09 cm. long, about 0.05 cm. in diameter at the base and 0.15 cm. in diameter at the orifice, villosulose within, the lobes oblong-elliptic, 0.3–0.35 cm. long, densely puberulent-papillate within, widely spreading; stamen filaments 0.18–0.22 cm. long, agglutinated to the style, the anthers 0.2 cm. long, glabrous; ovary ovoid, apocarpous, about 0.05 cm. long, densely papillate; stigma 0.18 cm. long; style 0.1 cm. long; nectaries about equalling the ovary; follicles unknown.

VENEZUELA: DISTRITO FEDERAL [?]: "prov. de Caracas, Curucuti," alt. 2000 pp., Febr., 1846, *Funck & Schlim 310* (BB, DC, TYPE, MBG, photograph and analytical drawings).

30. Forsteronia glabrescens Muell.-Arg. in Mart. Fl. Bras. 6[1]: 102. 1860.

Thyrsanthus glabrescens (Muell.-Arg.) Miers, Apoc. So. Am. 102. 1878.

Stems relatively stout, glabrous, conspicuously lenticellate when fully mature; leaves opposite, shortly petiolate, elliptic, apex shortly acuminate to subobtuse, base obtuse to acute, frequently more or less cuneate, 3.0–6.5 cm. long, 1.2–2.7 cm. broad, firmly membranaceous to subcoriaceous, glabrous; petioles 0.2–0.6 cm. long, glabrous; inflorescence amply thyrsiform, terminal, about equalling or somewhat surpassing the subtending leaves, bearing many small, white flowers; primary peduncle minutely puberulent, ultimate branches puberulent-papillate, determinately composed; pedicels 0.05–0.1 cm. long, puberulent-papillate; bracts ovate, 0.05–0.25 cm. long, scarious or only slightly foliaceous; calyx-lobes ovate, acute to obtuse, 0.1–0.12 cm. long, scarious, very minutely papillate to essentially glabrous without, the squamellae 3–5 times as many as the lobes, indefinitely and regularly distributed; corolla glabrous without, the tube 0.08–0.1 cm. long, about 0.05–0.07 cm. in diameter at the base and 0.1–0.15 cm. in diameter at the orifice, minutely villosulose within, the lobes 0.25–0.34 cm. long, pilosulose within, widely spreading; stamen filaments 0.13–0.2 cm. long, agglutinated to the style, the anthers 0.15–0.2 cm. long, glabrous, wholly exserted; stigma 0.11–0.14 cm. long; style 0.08–0.11 cm. long; ovary ovoid, minutely papillate, apocarpous, about 0.04 cm. long; nectaries somewhat shorter than the ovary; follicles relatively slender, rather distantly moniliform, subparallel or more or less tortuose, 15–33 cm. long, glabrous; seeds 0.65–0.75 cm. long, the pale tawny coma 2.7–3.2 cm. long.

BRAZIL: SÃO PAULO: Batataes, March, 1849, *Regnell III 882* (S); PARANA: Fortaleza, in silvula, Febr. 26, 1910, *Dusen, 9487* (D, FM, MBG, S, US); RIO GRANDE DO SUL: Uferwald des Rio Camaquam, 1887, *Ihering 8* (B); in margine silvula, loco sat sicco, Cachoeira, Febr. 20, 1893, *Malme 602* (S); Ilha dos Marinheiros pr. Rio Grande, in arena plus minusve mobilis, Nov. 24, 1892, *Malme 364* (S); in margine silvularum, loco sat sicco, Porto Alegre, Nov. 3, 1892, *Malme 248* (S); in Waldringen an der Avenida Ernesto, Porto Alegre, Jan., 1899, *Reineck 467* (D); data incomplete, *Ihering 300* (B); DATA INCOMPLETE: *Sello 1473* (B).

Bolivia: tarija: Bermejo, alt. 1400 m., Nov. 30, 1903, *Fiebrig 2310* (B, D, M, S, U, US).

Paraguay: common in woods and hedges, Villarica, Nov. 9, 1928, *Jørgensen 3445* (FM, MBG, NY, US); Cordillere de Peribebuy au dessus de Mbatobi, Nov. 1, 1883, *Balansa 4606* (BB, D); dans les forêts, Paraguari, Oct. 1876–July, 1877, *Balansa 1369* (B, BB, Bx, D, S); bewaldetes Tal, Cordillera de Altos, Oct. 11, 1902, *Fiebrig 218* (B, D, FM, M); zwischen Rio Apa und Rio Aquidaban, San Luis, Oct. 31, 1908, *Fiebrig 4157* (B, D, M); in silva pr. Cerro Leon, June, 1895, *Hassler 417* (BB); in dumetis pr. Campo Duarte, Oct., 1885, *Hassler 1350* (BB); San Bernardino, June, year lacking, *Hassler 3032* (BB); ad marg, silvae, Cordillera de Altos, Oct., year lacking, *Hassler 3345* (B, BB); in regione fluminis Corrientes, Sept., year lacking, *Hassler 4528* (B, BB); in altaplanitie et decliviis "Sierra de Maracayu," Oct., year lacking, *Hassler 5136* (BB); in altaplanitie "Sierra de Amambay," Sept., 1912, *Hassler 11962* (B, D, FM); in regione lacus Ypacaray, Oct., 1913, *Hassler 12326* (B, D, MBG, US).

Argentina: formosa: Guayculee, Febr., 1918, *Jørgensen 3573* (BA, MBG); exact locality lacking, Nov., 1891, *Niederlein 67b* (B); chaco: Mocovi, Nov. 13, 1903, *Venturi 46* (BA, D, MBG, US); Las Palmas, Oct., 1917, *Jørgensen 1956* (BA, MBG, US); Rio de Oro, Dec. 7, 1892, *Niederlein 72* (B); misiones: Santa Ana, Sept. 20, 1912, *Rodriguez 3588* (BA, MBG); San Ignacio, Sept. 7, 1919, *Munies 3586* (BA, MBG); Posadas, Bonpland, in silva ad occid. versus, Jan. 23, 1908, *Ekman 1586* (NY, S); same locality, in fruticeto ad praed. "La Granja," Nov. 12, 1907, *Ekman 1585* (S); corrientes: Wald bei Riachuelo, Jan. 19, 1883, *Niederlein 83* (B).

Uruguay: artigas: Montes del Cuareim, May, 1901, *Arechavaleta 18* (B).

31. Forsteronia tarapotensis K. Sch. in Engl. Bot. Jahrb. **40**: 411. 1908, nom. nud.

Frutices volubiles; ramulis crassiusculis glabris maturitate conspicue lenticellatis; foliis oppositis breviter petiolatis lanceolatis oblongo-ellipticisve apice acuminatis basi obtusis 4.5–10.6 cm. longis 1.3–3.0 cm. latis membranaceis glaberrimis supra nervo medio pauciglanduligero; petiolis 0.3–0.5 cm. longis; inflorescentiis dense subspicato-thyrsiformibus terminalibus foliis conspicue brevioribus; pedunculo omnino puberulo; pedicellis 0.04–0.05 cm. longis minute puberulis; bracteis ovatis vel ovato-lanceolatis 0.1–0.2 cm. longis scariaceis vel paululo foliaceis; calycis laciniis ovatis acutis acuminatisve 0.18–0.2 cm. longis scariaceis extus dense minuteque puberulis squamellis minutis multis plus minusve regulariter positis; corollae tubo ca. 0.15 cm. longo basi ca. 0.08–0.1 cm. diametro metiente faucibus ca. 0.175–0.2 cm. diametro metientibus extus minute puberulo-papillatis intus villosulis lobis oblongo-ovatis 0.35–

0.55 cm. longis patulis extus omnino denseque puberulis intus villosulis; filamentis staminum 0.25–0.3 cm. longis stylum agglutinatis antheris 0.2–0.25 cm. longis glabris omnino exsertis; ovario ovoideo apocarpo ca. 0.07 cm. longo puberulo-papillato; stigmate ca. 0.18–0.2 cm. longo; stylo ca. 0.075 cm. longo; nectariis ovario conspicue brevioribus; folliculis ignotis.

Stems relatively stout, glabrous, conspicuously lenticellate when fully mature; leaves opposite, shortly petiolate, lanceolate to oblong-elliptic, apex acuminate, base obtuse, 4.5–10.6 cm. long, 1.3–3.0 cm. broad, firmly membranaceous, glabrous, above inconspicuously glandular at the base of the midrib; petioles 0.3–0.5 cm. long; inflorescence densely thyrsiform-subspiciform, terminal, conspicuously shorter than the subtending leaves, bearing numerous small, white flowers; peduncle rather densely puberulent, ultimate branches rather indefinitely congested, minutely puberulent; pedicels 0.04–0.05 cm. long, minutely puberulent; calyx-lobes ovate to ovate-lanceolate, acute to acuminate, 0.18–0.2 cm. long, scarious or only slightly foliaceous, the squamellae minute, numerous, regularly and indefinitely distributed; corolla-tube about 0.15 cm. long, about 0.08–0.1 cm. in diameter at the base and 0.175–0.2 cm. in diameter at the orifice, without minutely puberulent-papillate, villosulose within, the lobes oblong-ovate, 0.35–0.55 cm. long, densely puberulent without, villosulose within, widely spreading; stamen filaments 0.25–0.3 cm. long, agglutinated to the style, the anthers 0.2–0.25 cm. long, glabrous, wholly exserted; ovary ovoid, apocarpous, about 0.07 cm. long, puberulent-papillate; stigma about 0.18–0.2 cm. long; style about 0.075 cm. long; nectaries much shorter than the ovary; follicles unknown.

PERU: LORETO: im Buschwald, Tarapoto, Nov., 1902, *Ule 6561* (B, TYPE, D, MBG, photograph and analytical drawings); prope Tarapoto, 1855–6, *Spruce 4908* (Bx, Camb.); forest, Yurimaguas, Oct. 22, 1929, *Williams 3891* (FM); Tarapoto, Dec. 5, 1929, *Williams 5611* (FM, MBG).

Well distinguished from its immediate relatives by the small foliage and puberulent corollas. *Spruce 4908* was referred to *F. Pavonii* A. DC. (= *Apocynum cannabinum* L. var. *glaberrimum* A. DC.) by Miers (Apoc. So. Am. 243. 1878).

32. **Forsteronia myriantha** Donn. Sm. Bot. Gaz. **27**: 435. 1899.

Stems relatively stout, minutely puberulent to papillate when very young, soon becoming glabrate and conspicuously lenticellate; leaves opposite, shortly petiolate, elliptic to oval, apex acute to acuminate, occasionally obtuse, base obtuse to broadly acute, 4.5–10.0 cm. long, 2.0–4.5 cm. broad, membranaceous, inconspicuously glandular at the base of the midrib above, beneath glabrous, or infrequently rather sparsely and irregularly pilosulose to glabrate; petioles 0.2–0.45 cm. long; inflorescence rather densely and broadly thyrsiform, terminal, conspicuously surpassed by the subtending leaves, bearing many small, white flowers; primary peduncle minutely puberulent-papillate, rarely densely and conspicuously puberulent, ultimate branches determinate, puberulent-papillate to densely puberulent; pedicels 0.1–0.21 cm. long, puberulent to puberulent-papillate; bracts ovate-trigonal, acuminate, 0.1–0.3 cm. long, scarious; calyx-lobes ovate, broadly acute to obtuse, 0.1–0.12 cm. long, scarious, puberulent-papillate or rarely tomentulose without, the squamellae minute, many, indefinitely distributed and apparently adnate to the base of the lobes; corolla glabrous to very minutely papillate without, the tube 0.07–0.09 cm. long, about 0.05–0.07 cm. in diameter at the base and 0.15–0.17 cm. in diameter at the orifice, villosulose within, the lobes 0.25–0.3 cm. long, minutely pilosulose within, widely spreading; stamen filaments 0.12–0.18 cm. long, agglutinated to the style, the anthers 0.18–0.23 cm. long, widely exserted, glabrous; ovary ovoid, apocarpous, minutely puberulent-papillate, about 0.03 cm. long; stigma 0.08–0.13 cm. long; style 0.08–0.12 cm. long; nectaries somewhat shorter than the ovary; follicles unknown.

GUATEMALA: SANTA ROSA: Naranjo, alt. 1100 m., May, 1893, *Heyde & Lux 4533* (B, BB, FM, MBG, NY, US); ZACATEPEQUEZ: Embaulada, alt. 1800 m., Dec., 1889, *Heyde & Lux 4534* (B, BB, M, MBG, US); PETEN: La Libertad, April 6, 1933, *Lundell 2540* (FM).

COSTA RICA: ALAJUELA: collines de Santiago, près S. Ramon, alt. 1100–1200 m., April 25, 1901, *Brenes 14272* (B, FM, US); CARTAGO: bords du rio de Las Vueltas, Tucurrique, alt. 635 m., May, 1899, *Tonduz 13355* (B, D, FM, M, US); SAN JOSE [?]: Rio Hondo, May 8, 1903, *Pittier 16622* (B, US).

PANAMA: CANAL ZONE: Gatun Sta., Panama R. R., Febr. 11, 1860, *Hayes s.n.* (G, MBG, NY).

Heyde & Lux 4533 is conspicuous because of the densely puberulent inflorescence. The inflorescence of the species as a whole is densely puberulent-papillate, however, and since but a single specimen exists of the more conspicuously pubescent type, no taxonomic segregation has been attempted, other characters being quite in harmony with those other recorded specimens from Guatemala, Costa Rica, and Panama.

33. Forsteronia galbina Woodson, spec. nov.

Fruticosa volubilis; ramulis crassiusculis glabris vel juventate minutissime papillatis maturitate conspicue lenticellatis; foliis oppositis petiolatis ovalibus vel obovato-ellipticis apice obtusis vel brevissime acuminatis basi obtusis 4.5–8.0 cm. longis 2.7–4.0 cm. latis membranaceis supra glabris nervo medio basi inconspicue glanduligero subtus in axillis nervi medii minute barbellatis caeterumque glabris; petiolis 0.3–0.8 cm. longis; inflorescentiis latissime thyrsiformibus paene subcorymbosis terminalibus folia subaequantibus flores multas minutas galbinas gerentibus; pedunculo ramulisque puberulo-papillatis; pedicellis 0.12–0.15 cm. longis minute puberulo-papillatis; bracteis lanceolatis acuminatis 0.05–0.1 cm. longis scariaceis; calycis laciniis ovatis acutis acuminatisve 0.1–0.125 cm. longis extus dense puberulo-papillatis squamellis minutis numerosis basi plus minusve connatis; corollae tubo 0.07–0.1 cm. longo basi ca. 0.06–0.07 cm. diametro metiente faucibus ca. 0.15–0.175 cm. diametro metientibus extus minutissime papillato intus laxe villosulo lobis 0.25 cm. longis patulis extus minute puberulis puberulo-papillatisve intus glabriusculis; filamentis staminum ca. 0.09 cm. longis stylum agglutinatis antheris 0.19–0.21 cm. longis glabris omnino exsertis; ovario ovoideo apocarpo ca. 0.05 cm. longo puberulo-papillato; stigmate ca. 0.11 cm. longo; stylo ca. 0.09 cm. longo; nectariis ovarium paene aequantibus; folliculis desiderantibus.

Stems relatively stout, glabrous or minutely papillate when very young, soon becoming glabrate and conspicuously lenticellate when fully mature; leaves opposite, petiolate, oval to

obovate-elliptic, apex obtuse to very shortly acuminate, base obtuse, 4.5–8.0 cm. long, 2.7–4.0 cm. broad, membranaceous, above glabrous, inconspicuously glandular at the base of the midrib, beneath minutely barbellate in the axils of the midrib, otherwise glabrous; petioles 0.3–0.8 cm. long; inflorescence very broadly thyrsiform, almost subcorymbose, terminal, somewhat shorter than or about equalling the subtending leaves, bearing many small, yellowish-green flowers; peduncle puberulent-papillate, ultimate branches determinate, minutely puberulent-papillate; pedicels 0.12–0.15 cm. long, minutely puberulent-papillate; bracts lanceolate, acuminate, 0.05–0.1 cm. long, scarious; calyx-lobes ovate, acute to acuminate, 0.1–0.125 cm. long, scarious, densely puberulent-papillate without, the squamellae minute, numerous, in groups more or less connate at the base; corolla-tube 0.07–0.1 cm. long, about 0.06–0.07 cm. in diameter at the base and 0.15–0.175 cm. in diameter at the orifice, very minutely papillate without, laxly villosulose within, the lobes about 0.25 cm. long, widely spreading, minutely puberulent-papillate or puberulent without, essentially glabrous within; stamen filaments about 0.09 cm. long, agglutinated to the style, the anthers 0.19–0.21 cm. long, wholly exserted, glabrous; ovary apocarpous, ovoid, about 0.05 cm. long, puberulent-papillate; stigma about 0.11 cm. long; style about 0.09 cm. long; nectaries almost equalling the ovary; follicles unknown.

PERU: LORETO: Flutfreier Hochwald, Mündung d. Santiago, alt. 160 m., Sept. 24, 1924, *Tessmann 3967* (B, TYPE, D, MBG, photograph and analytical drawings).

This species is perhaps too closely related to the foregoing, of which it might be considered a variety. The geographical isolation, together with the rather slight morphological distinctions, however, has prompted its interpretation as a specific entity. Fruit of both *F. myriantha* and *F. galbina* is awaited with interest.

34. Forsteronia thyrsoidea (Vell.) Muell.-Arg. in Mart. Fl. Bras. 6[1]: 105. 1860; Miers, Apoc. So. Am. 247. 1878.

Stems relatively stout, more or less densely pilose or puber-

ulent when young, eventually becoming glabrate and conspicuously lenticellate when fully mature; leaves opposite, petiolate, oblong-elliptic to broadly oval, apex acuminate to acute or obtuse, base broadly obtuse to rounded, 4–12 cm. long, 1.5–5.0 cm. broad, firmly membranaceous, above minutely pilose to glabrous, inconspicuously glandular at the base of the midrib, beneath more or less densely puberulent generally, or barbellate in the axils of the midrib and otherwise glabrous; petioles 0.3–0.9 cm. long, indument as upon the stem; inflorescence rather narrowly and densely thyrsiform, terminal, somewhat shorter than the subtending leaves, bearing many small, greenish-yellow flowers; primary peduncle puberulent, ultimate branches determinate, puberulent to puberulent-papillate; pedicels 0.05–0.1 cm. long, puberulent to puberulent-papillate; bracts lanceolate to linear-lanceolate, 0.4–1.0 cm. long, conspicuously foliaceous; calyx-lobes lanceolate to ovate-lanceolate, long-acuminate, 0.1–0.3 cm. long, minutely puberulent-papillate without, conspicuously foliaceous, the alternate squamellae solitary or infrequently paired; corolla-tube 0.13–0.2 cm. long, about 0.07–0.125 cm. in diameter at the base and 0.15–0.2 cm. in diameter at the orifice, essentially glabrous without, villosulose within, the lobes oblong to oblong-ovate, 0.25–0.38 cm. long, widely spreading, papillate without, minutely villosulose at the base within; stamen filaments 0.18–0.3 cm. long, agglutinated to the style, the anthers 0.2–0.28 cm. long, glabrous, wholly exserted; ovary ovoid, apocarpous, about 0.05 cm. long, papillate; stigma 0.11–0.15 cm. long; style 0.1–0.25 cm. long; nectaries somewhat shorter than the ovary.

Var. **typica.**

Echites thyrsoidea Vell. Fl. Flum. 111. 1830; Icones **3**: *pl. 37.* 1827, except the fruit.

Forsteronia multinervia A. DC. in DC. Prodr. **8**: 437. 1844; Muell.-Arg. in Mart. Fl. Bras. **6**[1]: 104. 1860.

Forsteronia multinervia A. DC. δ *ovalifolia* Muell.-Arg. loc. cit. 105. 1860.

Thyrsanthus multinervius (A. DC.) Miers, Apoc. So. Am. 103. 1878.

Stems conspicuously pubescent when young, eventually becoming glabrate; leaves rather inconspicuously and irregularly pubescent to glabrate above, beneath more or less puberulent generally; follicles relatively stout, continuous or essentially so, sharply divaricate, 13–25 cm. long, glabrous or essentially so; seeds 1.0–1.6 cm. long, the tawny coma 3.2–4.7 cm. long; other characters as in the species.

BRAZIL: MINAS GERAES: Lagôa Santa, date lacking, *Warming s.n.* (C, NY); RIO DE JANEIRO: in fruticetis, collibus, pr. civ. R. Jan., Febr., 1829, *Lhotzky 55* (B); ad urbem, in silvis inter Gavea et Vista Chineza, Jan. 15, 1929, *Ducke 21810* (US); locality lacking, 1865, *Allemão s.n.* (DC); SÃO PAULO: ad ripas Rio Pardo, Barretos, Nov., 1917, *Frazão 8674* (B, U); Ilha da Quaeimada Grande, Nov. 6, 1920, *Gehrt 4555* (B); data incomplete, Dec. 5, 1875, *Mosen 4271* (S); RIO GRANDE DO SUL: Potreiro dos Duridos, Municipio Rio Pardo, Nov., 1928, *Jürgens 29* (B); DATA INCOMPLETE: *Riedel s.n.* (B, BB, G, NY, U); *Glaziou 17138* (B, Bx, C); *Luschnath s.n.* (C); *Sellow 635* (B).

PARAGUAY: dans les bois, Paraguari, Oct., 1874, *Balansa 1370b* (D, DC); Grande Picada de Caaguazu, April, 1876, *Balansa 1370a* (BB); in regione fluminis Alto Parana, 1909–10, *Fiebrig 6267* (B); in silva pr. Cordillera de Altos, Dec., 1885, *Hassler 1577* (BB); same locality, Nov., year lacking, *Hassler 3494* (B).

ARGENTINA: MISIONES: Santa Ana, Sept. 19, 1912, *Rodriguez 605* (BA, MBG); Picarda a San Pedro, Oct. 27, 1886, *Niederlein 2219* (B); data incomplete, Oct. 8, 1896, *Bettfreund 943* (B).

A very distinctive species because of the narrow inflorescence with conspicuous, foliaceous bracts. There appears to be little room for doubt that our specimens correspond to Vellozo's illustration with the exception of the three pairs of subparallel, moniliform follicles. Since the combination of such an inflorescence and foliage with such follicles, which closely resemble those of *F. pubescens* or *F. glabrescens*, is unknown in the flora as represented in our herbaria, the assumption appears to be justified that the illustration is an accidental composite.

Var. **glabriuscula** (A. DC.) Woodson, comb. nov.

Forsteronia mutinervia A. DC. β *glabriuscula* A. DC. in DC. Prodr. **8**: 437. 1844; Muell.-Arg. in Mart. Fl. Bras. **6**[1]: 105. 1860.

Forsteronia obscura Rusby, Mem. Torrey Bot. Club **4**: 219. 1895.

Stems minutely and inconspicuously puberulent when very young, soon becoming glabrate; leaves glabrous above, beneath rather inconspicuously barbellate in the axils of the midrib; follicles unknown; other characters as in the species.

BRAZIL: RIO DE JANEIRO: inter Cabo Frio et Campos, 1829, *Vidensis s.n.* (Bx); data incomplete, *Glaziou 4092* (B); SANTA CATHARINA: an der Garciastrasse bei Blumenau, Nov., 1888, *Ule 1161* (B).

BOLIVIA: "Songo," Nov., 1890, *Bang 855* (B, BB, D, FM, M, MBG, NY, US).

It appears possible that this entity may represent an artificial collection of spontaneous variations assuming a like aspect independently. Although such a view may be supported by the rather incongruent distribution of the few specimens cited in the foregoing paragraphs, the plants themselves are remarkably similar, and conspicuous intergradation to the typical variety is lacking as yet.

35. **Forsteronia Velloziana** (A. DC.) Woodson, Ann. Mo. Bot. Gard. **21**: 622. 1934.

Echites bracteata Vell. Fl. Flum. 112. 1830; Icones **3**: *pl. 41.* 1827, not HBK.

Echites Velloziana A. DC. in DC. Prodr. **8**: 474. 1844.

Forsteronia multinervia A. DC. γ *microphylla* Muell.-Arg. in Mart. Fl. Bras. **6**[1]: 105. 1860.

Forsteronia ? bracteata (Vell.) Muell.-Arg. loc. cit. 106. 1860.

Thyrsanthus bracteatus (Vell.) Miers, Apoc. So. Am. 102. 1878.

Forsteronia microphylla (Muell.-Arg.) Handel-Mzt. Denkschr. K.K. Akad. Wiss. Wien **79**: 388. 1931 (reprint, 12. 1910).

Stems relatively stout, conspicuously ferruginous-hirsutulose when young, eventually becoming glabrate and conspicuously lenticellate when fully mature; leaves opposite, very shortly petiolate, nearly subsessile, oblong-elliptic to broadly oval, apex shortly and abruptly acuminate to obtuse, base broadly obtuse or rounded, occasionally almost subcordate, 2.5–7.0 cm. long, 1–4 cm. broad, firmly membranaceous, above rather sparsely and minutely hirtellous to glabrate, incon-

spicuously glandular at the base of the midrib, beneath finely and generally puberulent; petioles 0.15–0.35 cm. long, indument as upon the stem; inflorescence densely subcorymbose-thyrsiform, terminal, conspicuously shorter than the subtending leaves, bearing few to numerous small, white or greenish flowers; peduncle hirtellous throughout; pedicels 0.08–0.1 cm. long, minutely hirtellous; bracts lanceolate to linear-lanceolate, somewhat foliaceous, 0.1–0.8 cm. long; calyx-lobes lanceolate, acuminate, 0.25–0.4 cm. long, minutely puberulent without, the alternate squamellae solitary or infrequently paired; corolla-tube 0.1–0.12 cm. long, minutely papillate or essentially glabrous without, puberulent within, about 0.1–0.13 cm. in diameter at the base and 0.15–0.23 cm. in diameter at the orifice, the lobes oblong-ovate, 0.3–0.4 cm. long, only slightly spreading, puberulent-papillate without, papillate within; stamen filaments 0.1–0.15 cm. long, agglutinated to the style, the anthers 0.23–0.29 cm. long, glabrous, wholly exserted; ovary apocarpous, ovoid, about 0.45 cm. long, minutely puberulent-papillate; stigma 0.12–0.17 cm. long; style about 0.1 cm. long; nectaries somewhat shorter than the ovary; follicles relatively short and stout, 5–10 cm. long, glabrous, or sparsely and minutely hirtellous when immature, divaricate; seeds 0.6–0.8 cm. long, the tawny coma 2.3–2.6 cm. long.

BRAZIL: RIO DE JANEIRO: data incomplete, *Glaziou 7757* (B); MINAS GERAES: Caete, Nov., 1915, *Hoehne 6623* (B); S. de Antonio Pereira, Oct. 27, 1892, *Schwacke 8754* (B); in virgultis, Ouro Preto, Oct. 20, 1895, *Schwacke 11854* (B); data incomplete: *Widgren 52* (Bx, S); *Widgren 51* (B, S); *Regnell III 877* (B, FM, S, US); SÃO PAULO: Botucatu, Nov., 1896, *Novaes 384* (US); Rio Pequeno, Butantan, Oct. 28, 1918, *Hoehne 2549* (B); Morro-Pellado, Ityrapina, Jan., 1901, *Edwall 11147* (B); PARANA: ad marg. silvulae, Jaguariahyva, Nov. 5, 1910, *Dusen 10366* (D, FM, MBG, NY, US); DATA INCOMPLETE: *Sellow 36* (B).

There can be no question that this entity is entitled to full specific rank. Its characteristic inflorescence, virtually erect corolla-lobes, vegetative indument, and short follicles are quite uniform throughout the specimens examined.

36. **Forsteronia chiriquensis** Woodson, spec. nov.

Fruticosa volubilis; ramulis sat crassiusculis juventate laxe ferrugineo-hirtellis maturitate glabratis conspicue lenticel-

latis; foliis oblongo- vel obovato-ellipticis apice abrupte breviterque subcaudato-acuminatis basi late obtusis 7–10 cm. longis 3.2–3.8 cm. latis membranaceis supra glabris glabratisve nervo medio basi pauciglanduligero subtus in axillis nervi medii inconspicue barbellatis; petiolis 0.3–0.5 cm. longis ut in ramulis vestitis; inflorescentiis subspiciformi-thyrsiformibus terminalibus folia subaequantibus flores multas viridi-albidas (?) gerentibus; pedunculo hirtello ramulis vix manifestis glomeratis; pedicellis vix manifestis subnullis; bracteis lanceolatis vel ovato-lanceolatis 0.1–0.45 cm. longis subfoliaceis; calycis laciniis ovato-lanceolatis acuminatis 0.25–0.3 cm. longis minute irregulariterque puberulo-papillatis squamellis alternatis 1–2; corollae tubo 0.1 cm. longo basi ca. 0.05 cm. diametro metiente faucibus ca. 0.175 cm. diametro metientibus extus glabriusculo intus villosulo lobis oblongis 0.28–0.3 cm. longis patulis extus minute papillatis intus minute puberulo-papillatis; filamentis staminum 0.17–0.2 cm. longis stylum agglutinatis antheris ca. 0.25 cm. longis omnino exsertis glabris; ovario apocarpo ovoideo ca. 0.06 cm. longo minute hirtello; stigmate 0.15 cm. longo; stylo 0.18 cm. longo; nectariis ovario brevioribus; folliculis ignotis.

Stems relatively stout, rather laxly ferruginous-hirtellous when young, eventually becoming glabrate and conspicuously lenticellate when fully mature; leaves opposite, shortly petiolate, oblong- to obovate-elliptic, apex shortly and abruptly subcaudate-acuminate, base broadly obtuse, 7–10 cm. long, 3.2–3.8 cm. broad, membranaceous, above glabrous or glabrate, glandular at the base of the midrib, beneath inconspicuously barbellate in the axils of the midrib; petioles 0.3–0.5 cm. long, indument as upon the stem; inflorescence subspiciform-thyrsiform, terminal, about equalling the subtending leaves, bearing numerous small, greenish-white (?), subsessile flowers; peduncle hirtellous, the ultimate branches extremely reduced and indefinitely manifest; pedicels scarcely manifest; bracts lanceolate to ovate-lanceolate, 0.1–0.45 cm. long, subfoliaceous; calyx-lobes ovate-lanceolate, acuminate, 0.25–0.3 cm. long, minutely and irregularly puberulent-papillate without, the alter-

nate squamellae solitary or paired; corolla-tube about 0.1 cm. long, about 0.05 cm. in diameter at the base and 0.175 cm. in diameter at the orifice, essentially glabrous without, villosulose within, the lobes oblong, 0.28–0.3 cm. long, widely spreading, minutely papillate without, minutely puberulent-papillate within; stamen filaments 0.17–0.2 cm. long, agglutinated to the style, the anthers about 0.25 cm. long, wholly exserted, glabrous; ovary apocarpous, ovoid, about 0.06 cm. long, minutely hirtellous; stigma 0.15 cm. long; style 0.18 cm. long; nectaries somewhat shorter than the ovary; follicles unknown.

PANAMA: CHIRIQUI: data incomplete, May, 1858, *Wagner s.n.* (M, TYPE, MBG, photograph and analytical drawings).

This species suggests *F. thyrsoidea* of southeastern South America, but differs notably in the subspiciform construction of the inflorescence. Additional material is greatly to be desired.

37. **Forsteronia Pycnothyrsus** K. Sch. in herb.

Fruticosa volubilis; ramulis sat crassis juventate dense laxeque ferrugineo-hirtellis maturitate glabratis conspicue lenticellatis; foliis oppositis breviter petiolatis oblongo-ovalibus apice acutis obtusisve basi late obtusis rotundatisve 4.0–4.5 cm. longis 1.8–2.2 cm. latis membranaceis supra sparse minuteque hirtellis nervo medio basi inconspicue glanduligero subtus dense puberulis; petiolis 0.35–0.4 cm. longis ut in ramulo vestitis; inflorescentiis subspiciformi-thyrsiformibus terminalibus folia conspicue superantibus flores multas parvas viridi-albidas (?) gerentibus; pedunculo minute ferrugineo-hirtello ramulis glomeratis vix manifestis; pedicellis 0.03–0.05 cm. longis minute puberulis; bracteis ovatis 0.1–0.2 cm. longis scariaceis; calycis laciniis late ovatis obtusis rotundatisve 0.13–0.15 cm. longis scariaceis extus dense minuteque puberulis squamellis alternatis solitariis; corollae tubo 0.1 cm. longo basi ca. 0.07 cm. diametro metiente faucibus ca. 0.15 cm. diametro metientibus extus glabriusculo vel indistincte papillato intus villosulo lobis oblongis 0.25 cm. longis patulis extus puberulo-papillatis intus dense pilosulis; filamentis staminum 0.18 cm.

longis antheris ca. 0.2 cm. longis omnino exsertis glabris; ovario apocarpo ovoideo ca. 0.035 cm. longo minute hirtello; stigmate 0.14–0.15 cm. longo; stylo 0.1 cm. longo; nectariis ovario brevioribus; folliculis ignotis.

Stems relatively stout, densely and laxly ferruginous-hirtellous when young, eventually becoming glabrate and conspicuously lenticellate when fully mature; leaves opposite, petiolate, oblong-oval, apex acute to obtuse, base broadly obtuse or rounded, 4.0–4.5 cm. long, 1.8–2.2 cm. broad, membranaceous, above sparsely and minutely hirtellous, inconspicuously glandular at the base of the midrib, beneath densely puberulent; petioles 0.35–0.4 cm. long, indument as upon the stem; inflorescence subspiciform-thyrsiform, terminal, conspicuously surpassing the subtending leaves, bearing many small, greenish-white (?) flowers; primary peduncle minutely ferruginous-hirtellous, the ultimate branches glomerate, scarcely manifest; pedicels 0.03–0.05 cm. long, minutely puberulent; bracts ovate, 0.1–0.2 cm. long, scarious; calyx-lobes broadly ovate, obtuse to rounded, 0.13–0.15 cm. long, densely and minutely puberulent without, the alternate squamellae solitary; corolla-tube 0.1 cm. long, about 0.07 cm. in diameter at the base and 0.15 cm. in diameter at the orifice, minutely and indistinctly papillate or essentially glabrous without, villosulose within, the lobes oblong, 0.25 cm. long, widely spreading, puberulent-papillate without, densely pilosulose within; stamen filaments 0.18 cm. long, the anthers about 0.2 cm. long, wholly exserted, glabrous; ovary apocarpous, ovoid, about 0.035 cm. long, minutely hirtellous; stigma 0.14–0.15 cm. long; style 0.1 cm. long; nectaries somewhat shorter than the ovary; follicles unknown.

Colombia or Ecuador: data incomplete, *Lehmann 7885* (B, type, FM, MBG, photograph and analytical drawings).

Closely related to the preceding, from which it may be distinguished by its smaller foliage, smaller, ovate calyx-lobes, and inconspicuous, scarious bracts. It is guessed that Ecuador may be the true provenience of this species, as the apocynaceous flora of upper Panama and Ecuador have shown several

notable affinities. Additional specimens and reliable data are greatly to be desired for this species.

38. **Forsteronia adenobasis** Muell.-Arg. Linnaea **30**: 412. 1860.

Thyrsanthus adenobasis (Muell.-Arg.) Miers, Apoc. So. Am. 96. 1878.

Stems relatively stout, minutely ferruginous-tomentulose when very young, soon becoming glabrate and conspicuously lenticellate when fully mature; leaves opposite, petiolate, broadly oval, apex very abruptly and shortly acuminate to obtuse, base obscurely and broadly cordate, 5.0–10.5 cm. long, 2.8–7.0 cm. broad, firmly membranaceous, above glabrous or minutely and very inconspicuously pubescent along the veins, glandular at the base of the midrib, beneath minutely and densely tomentulose; petioles 0.8–1.0 cm. long; inflorescence rather narrowly pyramidal-thyrsiform, terminal, about equalling to conspicuously surpassing the subtending leaves, bearing many small, white flowers; primary peduncle minutely ferruginous-tomentulose, ultimate branches determinate, minutely tomentulose; pedicels 0.13–0.2 cm. long, minutely tomentulose; bracts ovate, 0.1–0.25 cm. long, scarious; calyx-lobes ovate, acute, 0.1–0.2 cm. long, densely and minutely puberulent-papillate without, the alternate squamellae very minute, solitary; corolla-tube 0.1 cm. long, about 0.07–0.1 cm. in diameter at the base and 0.15–0.2 cm. in diameter at the orifice, without minutely and irregularly puberulent-papillate, essentially glabrous toward the base, within minutely villosulose, the lobes ovate-oblong, 0.25–0.3 cm. long, somewhat spreading, densely puberulent-papillate without, densely pilosulose within; stamen filaments 0.12–0.15 cm. long, agglutinated to the style above, the anthers 0.17–0.19 cm. long, wholly exserted, glabrous; ovary apocarpous, ovoid, about 0.03 cm. long, minutely hirtellous; stigma 0.15–0.17 cm. long; style 0.05–0.08 cm. long; nectaries about equalling the ovary, minutely pilosulose at the tips; follicles unknown.

British Guiana: ad ripas fl. Pomeroon, Sept., 1843, *Schomburgk 1438* (B, type, MBG, photograph and analytical drawings); in mixed forest, Moraballi Creek,

near Bartica, alt. near sea-level, Oct. 10, 1929, *Sandwith 416* (K, NY, S, U, US); "Roraima," data incomplete, 1842–3, *Schomburgk 707* (B, BB, D, COTYPES).

39. **Forsteronia umbellata** (Aubl.) Woodson, comb. nov.

Apocynum umbellatum Aubl. Hist. Pl. Gui. Fr. **1**: 275; **3**: *pl. 108*. 1775.

Thenardia umbellata (Aubl.) Spreng. Syst. **1**: 636. 1825.

Thenardia (?) corymbosa Benth. in Hook. Jour. Bot. **3**: 246. 1841.

Forsteronia Schomburgkii A. DC. in DC. Prodr. **8**: 438. 1860, not Muell.-Arg.

Forsteronia Schomburgkii A. DC. β *umbellata* (Aubl.) A. DC. loc. cit. 1860.

Forsteronia macrophylla Muell.-Arg. Linnaea **30**: 411. 1860.

Thyrsanthus macrophyllus (Muell.-Arg.) Miers, Apoc. So. Am. 96. 1878.

Thyrsanthus Aubletianus Miers, loc. cit. 98. 1878.

Thyrsanthus corymbiferus Miers, loc. cit. 1878.

Stems relatively stout, minutely and inconspicuously puberulent when very young, soon becoming glabrate and conspicuously lenticellate when fully mature; leaves opposite, petiolate, broadly oval to oblong-oval, apex very abruptly and shortly acuminate-subcuspidate to obtuse, base rounded, frequently obscurely cordate, 7.8–15.0 cm. long, 4.5–9.2 cm. broad, firmly membranaceous, above glabrous, or minutely and indefinitely puberulent along the veins, glandular at the base of the midrib, beneath very minutely and generally puberulent or tomentulose; petioles 0.6-1.3 cm. long; inflorescence broadly subcorymbose-thyrsiform, terminal, shorter than the subtending leaves, bearing many small, white flowers; primary peduncle puberulent-papillate, ultimate branches determinate, puberulent-papillate throughout; pedicels 0.2–0.3 cm. long, minutely puberulent; bracts ovate, 0.1–0.25 cm. long, scarious or only slightly foliaceous; calyx-lobes ovate, acuminate, scarious or only slightly foliaceous, densely and minutely puberulent without, 0.15–0.17 cm. long, the alternate squamellae solitary, very minute; corolla-tube 0.125–0.15 cm. long, about 0.07–0.1 cm. in diameter at the base and 0.15–0.2 cm. in diameter at the ori-

fice, irregularly and minutely puberulent-papillate without, villosulose within, the lobes broadly oblong, somewhat spreading, 0.3–0.35 cm. long, densely and minutely puberulent-papillate without, within densely and minutely pilosulose; stamen filaments 0.15–0.25 cm. long, the anthers 0.25 cm. long, barbellate at the tips, wholly exserted; ovary apocarpous, ovoid, about 0.07 cm. long, minutely hirtellous; stigma 0.18–0.2 cm. long; style 0.07–0.15 cm. long; nectaries nearly as long as the ovary, minutely barbellate; follicles unknown.

French Guiana: Cayenne, date lacking, *collector unknown* (DC, MBG, photograph and analytical drawings).

Brazil: para: silva paludosa, Belem do Para, Oct. 31, 1926, *Ducke 21598* (B, U, US); silva non inundata, Bragança, Jan. 14, 1923, *Ducke 17482* (B).

The specimens cited above agree remarkably well with Aublet's illustration, particularly that from French Guiana, the type specimen of *F. macrophylla* Muell.-Arg.

40. Forsteronia Sandwithiana Woodson, spec. nov.

Fruticosa volubilis; ramulis sat crassiusculis, juventate minute inconspicueque ferrugineo-tomentulosis mox glabratis maturitate conspicue lenticellatis; foliis oppositis breviter petiolatis oblongo-ellipticis vel ovalibus apice abrupte brevissimeque acuminatis basi obscure cordatis 4.5–10.0 cm. longis 1.6–5.8 cm. latis firme membranaceis subcoriaceisve supra glabris nervo medio basi pauciglanduligero subtus nervo medio venisque minutissime puberulo-papillatis caeterumque glabris; petiolis 0.4–0.9 cm. longis minute puberulo-papillatis; inflorescentiis dense subcorymboso-thyrsiformibus terminalibus foliis multo brevioribus flores multas parvas virides gerentibus; pedunculo minutissime puberulo-papillato; pedicellis 0.12–0.2 cm. longis minute puberulo-papillatis; bracteis ovatis 0.1–0.15 cm. longis scariaceis; calycis laciniis lanceolatis acuminatis 0.3–0.35 cm. longis subfoliaceis extus minute puberulo-papillatis squamellis alternatis minutissimis solitariis; corollae tubo 0.13–0.15 cm. longo basi ca. 0.1 cm. diametro metiente faucibus ca. 0.13 cm. diametro metientibus extus minute papillatis intus lanulosis lobis late oblongis 0.4–0.42 cm. longis vix patulis extus puberulo-papillatis intus conspicue pilosulosis;

filamentis staminum 0.2–0.25 cm. longis antheris ca. 0.3 cm. longis omnino exsertis apice minute sparseque barbellatis; ovario apocarpo ovoideo ca. 0.05 cm. longo minute hirtello; stigmate 0.2 cm. longo; stylo 0.15–0.2 cm. longo; nectariis ovarium vix aequantibus glabris; folliculis ignotis.

Stems relatively stout, minutely and inconspicuously ferruginous-tomentulose when very young, soon becoming glabrate and conspicuously lenticellate when fully mature; leaves opposite, shortly petiolate, oblong-elliptic to oval, apex abruptly and very shortly acuminate, base obscurely cordate, 4.5–10.0 cm. long, 1.6–5.8 cm. broad, firmly membranaceous to subcoriaceous, above glabrous or essentially so, inconspicuously glandular at the base of the midrib, beneath very minutely puberulent upon the veins and midrib, otherwise glabrous; petioles 0.4–0.9 cm. long, minutely puberulent-papillate; inflorescence densely subcorymbose-thyrsiform, terminal, much shorter than the subtending leaves, bearing many small, green flowers; primary peduncle very minutely puberulent-papillate, ultimate branches determinate, minutely puberulent-papillate; pedicels 0.12–0.2 cm. long, minutely puberulent-papillate; bracts ovate, 0.1–0.15 cm. long, scarious; calyx-lobes lanceolate, long-acuminate, 0.3–0.35 cm. long, subfoliaceous, minutely puberulent-papillate without, the squamellae very minute, alternate, solitary; corolla-tube 0.13–0.15 cm. long, about 0.1 cm. in diameter at the base and 0.13 cm. in diameter at the orifice, minutely papillate without, within lanulose, the lobes broadly oblong, 0.4–0.42 cm. long, slightly spreading, puberulent-papillate without, within conspicuously and densely pilosulose; stamen filaments 0.2–0.25 cm. long, agglutinated to the style, the anthers 0.3 cm. long, wholly exserted, minutely and sparsely barbellate at the tips; ovary apocarpous, ovoid, about 0.05 cm. long, minutely hirtellous; stigma 0.2 cm. long; style 0.15–0.2 cm. long; nectaries somewhat shorter than the ovary, glabrous; follicles unknown.

British Guiana: in mora forest, Moraballi Creek, near Bartica, alt. near sea-level, Sept. 24, 1929, *Sandwith 334* (K, NY, type, U, MBG, photograph and analytical drawings); data incomplete, *Jenman 6316* (K, NY).

F. umbellata, F. adenobasis, and *F. Sandwithiana* form an extremely natural and closely knit group of species centering in the Guianas and northeastern Brazil. The group is distinguished from the neighboring species of *Forsteronia* having stamens wholly exserted by the larger leaves of somewhat firmer texture, the slightly spreading corolla-lobes, and the somewhat slighter tendency for the staminal filaments to become agglutinated to the style. As a matter of fact, the agglutination may not actually exist in *F. umbellata,* as the herbarium specimens available for dissection have been inconclusive in this regard. In *F. adenobasis* agglutination of the staminal filaments occurs only toward the apex of the style. *F. Sandwithiana* is distinguished from its immediately related congeners by means of its practically glabrous foliage, small, densely subcorymbose-thyrsiform inflorescence, and relatively long, subfoliaceous calyx-lobes. Mr. Sandwith describes the aspect of the liana as follows: ''Bush-rope in mora forest. Fl. green, but hairs in the throat and at tops of anthers are white.''

41. Forsteronia spicata (Jacq.) G. F. W. Meyer, Fl. Esseq. 135. 1818; A. DC. in DC. Prodr. **8**: 437. 1844.

Echites spicata Jacq. Enum. Pl. Carib. 13. 1760; Select. Stirp. Am. Hist. **1**: 34; **2**: *pl. 29.* 1763.

Parsonsia spicata (Jacq.) R. Br. Mem. Wern. Soc. **1**: 65. 1811.

Thyrsanthus corylifolia Griseb. Mem. Amer. Acad. N. S. **8**: 519. 1863.

Forsteronia corylifolia Griseb. Cat. Pl. Cub. 172. 1866.

Thyrsanthus spicatus (Jacq.) Miers, Apoc. So. Am. 95. 1878.

Aptotheca corylifolia (Griseb.) Miers, loc. cit. 150, *pl. 21B.* 1878.

Stems relatively stout, minutely ferruginous-tomentulose when young, eventually becoming glabrate and conspicuously lenticellate when fully mature; leaves opposite, shortly petiolate, broadly oval to obovate-elliptic, apex very abruptly and shorty subcaudate-acuminate, infrequently to acute or obtuse

upon the lower, base broadly obtuse or rounded, 6–16 cm. long, 3.5–9.0 cm. broad, firmly membranaceous, above very sparsely and minutely pilosulose, more densely so along the veins, occasionally glabrate, inconspicuously glandular at the base of the midrib, beneath minutely and rather sparsely tomentulose, rarely glabrate; petioles 0.4–1.0 cm. long, indument as upon the stem; inflorescence subspiciform-thyrsiform, both terminal and lateral at the upper nodes, much shorter than the subtending leaves, bearing numerous small, white flowers; primary peduncle minutely ferruginous-tomentulose, ultimate branches extremely reduced; pedicels usually less than 0.05 cm. long, scarcely manifest; bracts ovate, 0.1–0.5 cm. long, somewhat foliaceous; calyx-lobes ovate, acute to acuminate, 0.25–0.4 cm. long, densely and minutely tomentulose without, slightly foliaceous, the alternate squamellae solitary, or rarely in groups of 2–3; corolla-tube 0.15–0.21 cm. long, about 0.1–0.12 cm. in diameter at the base, 0.2–0.25 cm. in diameter at the orifice, without essentially glabrous or minutely papillate above, villosulose within, the lobes oblong-ovate, 0.35–0.4 cm. long, widely spreading, puberulent-papillate without, densely pilosulose within; stamen filaments 0.25–0.3 cm. long, agglutinated to the style, the anthers 0.23–0.28 cm. long, widely exserted, glabrous; ovary syncarpous, ovoid, about 0.065 cm. long, densely tomentulose; stigma 0.12–0.16 cm. long; style 0.16–0.23 cm. long; nectaries much shorter than the ovary; follicles syncarpous, relatively stout and rigid, continuous, 12–19 cm. long, minutely and densely ferruginous-tomentulose when immature, eventually becoming glabrate; seeds 0.9–1.0 cm. long, the brilliantly tawny coma 3.1–4.5 cm. long.

CUBA: HAVANA: near mangrove swamps at Boca Ciega between Tarara and Guanabo, in thickets a little farther inland, Oct. 15, 1921, *Ekman 13334* (B, S); Tarapaste, Lomas de la Jaula, in frut. scand., June 11, 1914, *Ekman 1297* (B, S); MATANZAS: near mouth of the Bueyvaca, Aug. 28, 1903, *Britton & Wilson 10* (NY); SANTA CLARA: climbing on trees, attractive to bees, La Sierra, alt. 500–800 ft., July 9, 1929, *Jack 7397* (AA, FM, NY, S, US); climbing on bushes and trees, mahogany pasture, Limones, Soledad, Cienfuegos, July 16, 1930, *Jack 8013* (AA, FM, S, US); climbing on trees, Guabairo, Soledad, Cienfuegos, Nov. 26, 1928, *Jack 6730* (AA, FM, S); ad Pozo Azul, alt. 150 m., April, 1889, *Eggers 5347* (B); ORIENTE: in pascuis, vulgar, Santiago (ad Santiago Bay), Oct. 21, 1916, *Ekman 8020* (S); in dumetis ad Rio Jagua, Bayate, July 10, 1915, *Ekman 6221* (S); in

sylva, Sabanaso (prope Mir ad occident. versus), Oct. 26, 1915, *Ekman 6514* (S); ad Rio Grande prope Sevilla, July 1, 1918, *Ekman 9314* (S); DATA INCOMPLETE: *Wright 1664* (B, BB, Bx, Camb., D, G, MBG, NY, S, US).

MEXICO: GUERRERO: Acapulco, date lacking, *Henke s.n.* (M); Llanos de Temalhuacan, alt. 50 m., July 31, 1898, *Langlassé 261* (B, D, US); CHIAPAS: banks of creek near Monserrate, July, 1925, *Purpus 10347* (NY).

GUATEMALA: ZACAPA: Gualan, alt. 620 ft., June 20, 1909, *Deam 6368* (FM, G, MBG, NY, US).

NICARAGUA: MANAGUA: exact locality lacking, Oct. 8, 1927, *Chaves 313* (FM, US).

SAN SALVADOR: SANTA ANA: exact locality lacking, 1924, *Calderon 2176* (US).

COLOMBIA: MAGDALENA: Santa Marta, alt. 100 ft., May, 1898-1901, *H. H. Smith 884* (B, Bx, D, FM, G, MBG, NY, S, U, US); ATLANTICO: Barranquilla, June, 1927, *Elias 222* (US); DATA INCOMPLETE: "Rio Magdal., April, 1801," *Humboldt & Bonpland 1296* (B); "Nova Granata," date lacking, *Triana 1920* (B).

This species breaks down the carpological distinction between the American *Forsteronia* and the Asiatic *Parsonsia*. The affinity of *F. spicata* is distinctly with the remaining American species, however. It appears probable that the only absolute morphological distinction of *Forsteronia* and *Parsonsia* capable of superficial detection may lie in the presence or absence of the dorsal foliar foveae. The use of this character among certain genera of Apocynaceae indigenous to the Old and the New Worlds is intended for publication in the near future.

42. Forsteronia simulans Woodson, Ann. Mo. Bot. Gard. **21**: 621. 1934.

Stems relatively stout, glabrous, conspicuously lenticellate when fully mature; leaves opposite, shortly petiolate, oblong-elliptic, apex acute, base obtuse to somewhat cuneate, 2–5 cm. long, 0.7–2.2 cm. broad, coriaceous or subcoriaceous, glabrous throughout, above inconspicuously glandular at the base of the midrib, beneath paler, the secondary venation subhorizontal; petioles 0.3–0.5 cm. long; inflorescence corymbose-subumbellate, evidently simple (or very obscurely compound ?), terminal, about equalling the subtending leaves, bearing numerous small, yellowish-green flowers; peduncle minutely papillate; pedicels 0.5–0.6 cm. long, minutely papillate; bracts ovate-lanceolate, 0.15–0.2 cm. long, slightly foliaceous; calyx-lobes ovate, obtuse, 0.15–0.2 cm. long, glabrous or very minutely

papillate without, the alternate squamellae solitary; corolla-tube about 0.25 cm. long, about 0.125 cm. in diameter at the base, about 0.15 cm. in diameter at the orifice, essentially glabrous without, minutely puberulent within, the lobes oblong-ovate, obtuse, about 0.2 cm. long, spreading, essentially glabrous without and within, the margins minutely and rather sparsely ciliolate; staminal filaments about 0.15 cm. long, agglutinated to the style; anthers about 0.2 cm. long, wholly exserted, glabrous; ovary apocarpous, ovoid, about 0.06 cm. long, glabrous; stigma about 0.2 cm. long; style about 0.2 cm. long; nectaries about equalling the ovary; follicles unknown.

COLOMBIA: SANTANDER DEL NORTE: eastern slope of Paramo del Hatico, en route from Toledo to Pamplona, alt. 2300 m., edge of woods, March 12, 1927, *Killip & Smith 20568* (NY, TYPE, MBG, photograph and analytical drawings).

43. Forsteronia floribunda (Sw.) G. F. W. Meyer, Fl. Esseq. 135. 1818; A. DC. in DC. Prodr. **8**: 437. 1844; Miers, Apoc. So. Am. 243. 1878.

Echites floribunda Sw. Prodr. 52. 1788.

Parsonsia floribunda (Sw.) R. Br. Mem. Wern. Soc. **1**: 65, 1811.

Forsteronia Alexandri Griseb. Fl. Brit. W. I. 412. 1861.

Stems relatively stout, glabrous or essentially so, very inconspicuously and minutely lenticellate when fully mature; leaves opposite, shortly petiolate, oblong-elliptic to broadly oval, apex very shortly and abruptly acuminate to obtuse, base broadly obtuse, 4–11 cm. long, 0.8–5.0 cm. broad, coriaceous, glabrous throughout, the secondary venation subhorizontal and relatively dense, eglandular, somewhat nitidulous above, conspicuously paler beneath; petioles 0.35–0.8 cm. long; inflorescence aggregate dichasial to thyrsiform, terminal, somewhat shorter than the subtending leaves, bearing many small, greenish-white flowers; peduncle very minutely papillate; pedicels 0.3–0.4 cm. long, somewhat accrescent in fruit, minutely papillate; bracts ovate, 0.05–0.15 cm. long, scarious, persistent; calyx-lobes ovate, acute to obtuse, 0.21–0.3 cm. long, essentially glabrous or very minutely and indefinitely papillate without, the alternate squamellae solitary or in groups of 2–3; corolla-tube 0.2–0.3 cm. long, about 0.08–0.125 cm. in diam-

eter at the base and 0.175–0.25 cm. in diameter at the orifice, glabrous or very minutely and indefinitely papillate without, villosulose within, the lobes oblong-lanceolate, acute to obtuse, 0.39–0.45 cm. long, widely spreading, essentially glabrous without and within; staminal filaments 0.3–0.4 cm. long, exappendiculate, agglutinated to the style, the anthers 0.25–0.3 cm. long, wholly exserted, glabrous; ovary apocarpous, ovoid, minutely and sparsely pilosulose to essentially glabrate, about 0.08 cm. long; stigma 0.1–0.12 cm. long; style 0.3–0.4 cm. long; nectaries somewhat shorter than the ovary; follicles relatively long and slender, continuous or only indefinitely undulated, subparallel or somewhat tortuous to sharply divaricate, 16–30 cm. long, glabrous; seeds 0.7–0.9 cm. long, the pale tawny coma 1.5–2.1 cm. long.

JAMAICA: woodlands near Newport, Parish of Manchester, Sept. 3–7, 1908, *Britton 3196* (B, FM, NY, US); rocky wooded hill, Troy, Cockpit Country, Sept. 13–18, 1906, *Britton 641* (NY); near Troy, alt. 2000 ft., April, 1916, *Perkins 1100* (B); same locality, March 23, 1917, *Perkins 1378* (B, D); Farm Pen, alt. 200 ft., Aug. 23, 1895, *Campbell 5831* (B, FM, NY); growing over bushes, road to Hagley Gap, alt. 1800 ft., July 10, 1903, *Harris 5903* (B, FM, NY); Stony Hill, Jan. 22, 1903, *Harris 8440* (B); Hope Gardens, June 3, 1903, *Harris 8599* (B, FM, US); Schwallenburgh, St. Ann, Jan. 26, 1898, *Harris 7042* (B, NY); data incomplete: *Alexander s.n.* (B, NY); *Bertero s.n.* (B); *Swartz s.n.* (S, TYPE, MBG, photograph and analytical drawings).

Popular names for this species are said to be "Milk Withe" and "Rubber Withe." Because of its isolation in Jamaica, it is remarkably constant and free of conspicuous variability. In this regard it resembles *Mandevilla torosa* (Jacq.) Woodson, also the only species of its genus upon the island.

44. Forsteronia peninsularis Woodson, spec. nov.

Fruticosa volubilis altitudine ignota; ramulis crassiusculis juventate minutissime puberulo-papillatis mox glabratis maturitate cortice brunneis conspicue lenticellatis; foliis oppositis longiuscule petiolatis oblongo-ellipticis apice anguste acutis acuminatisve basi obtusis 4.5–5.5 cm. longis 1.7–2.2 cm. latis firme membranaceis glaberrimis utrinque opacis eglandulosis nervis secundariis sat remotis arcuatis; petiolis 0.5–0.8 cm. longis glabris; inflorescentiis subthyrsiformibus terminalibus foliis paululo brevioribus flores multas parvas viridi-albidas

gerentibus; pedunculo minute puberulo-papillato; pedicellis 0.2–0.25 cm. longis ut in pedunculo vestitis; calycis laciniis ovatis obtusis 0.15 cm. longis extus puberulo-papillatis; corollae tubo 0.2 cm. longo basi ca. 0.08 cm. diametro metiente faucibus ca. 0.1–0.125 cm. extus prope orificium minute puberulo-papillato caeterumque glabro intus villosulo lobis oblongo-ellipticis obtusis 0.4–0.425 cm. longis ca. 0.125 cm. latis extus puberulo-papillatis intus papillatis reflexis; antheris 0.25 cm. longis valde exsertis filamentis stylum agglutinatis laxe pilosulis; ovario ovoideo ca. 0.1 cm. longo dense minuteque puberulo; nectariis haud concrescentibus ovarium ca. dimidio aequantibus; stigmate ca. 0.09 cm. longo; folliculis teretibus gracilibus glabris plus minusve falcatis maturitate non visis; seminibus ignotis.

Stems relatively stout, very minutely puberulent-papillate when young, soon becoming glabrate, conspicuously lenticellate when fully mature; leaves opposite, petiolate, oblong-elliptic, apex narrowly acute to acuminate, base obtuse, 4.5–5.5 cm. long, 1.7–2.2 cm. broad, firmly membranaceous, glabrous, opaque, eglandular, secondary venation relatively distant, arcuate; petiole 0.5–0.8 cm. long, glabrous; inflorescence subthyrsiform, broadly pyramidal in outline, terminal, somewhat shorter than the subtending leaves, bearing numerous greenish-white flowers; peduncle minutely puberulent-papillate; pedicels 0.2–0.25 cm. long, clothed with a similar indument to that of the peduncle; calyx-lobes ovate, obtuse, 0.15 cm. long, puberulent-papillate without; corolla-tube 0.2 cm. long, about 0.08 cm. in diameter at the base and 0.1–0.125 cm. at the orifice, minutely puberulent-papillate toward the orifice without, glabrous to glabrescent below, villosulose within, the lobes oblong-elliptic, obtuse, 0.4–0.425 cm. long, about 0.125 cm. broad, without puberulent-papillate, within papillate, reflexed; anthers 0.25 cm. long, glabrous, the filaments exappendiculate, laxly pilosulose, agglutinated to the style; ovary ovoid, apocarpous, about 0.1 cm. long, densely and minutely puberulent; stigma 0.09 cm. long; nectaries about half equalling the ovary; immature follicles terete, relatively slender, more or less falcate, glabrous; seeds unknown.

BRITISH HONDURAS: Maskall, Northern River, July 16, 1934, *Gentle 1281* (MBG, TYPE).

Differing from *F. floribunda* (Sw.) G. F. W. Meyer, which it closely simulates, in the firmly membranaceous texture and arcuate venation of the foliage, and conspicuously puberulent-papillate corolla.

45. **Forsteronia portoricensis** Woodson, Ann. Mo. Bot. Gard. **21**: 618. 1934.

Stems relatively stout, glabrous, or very minutely papillate when young, eventually becoming inconspicuously lenticellate when fully mature; leaves opposite, shortly petiolate, oblong-elliptic to oval, apex very shortly and abruptly acuminate to acute or obtuse, base broadly obtuse, 3.2–9.0 cm. long, 1.3–4.7 cm. broad, coriaceous, the margin somewhat revolute upon desiccation, secondary veins arcuate and relatively distant, wholly glabrous, eglandular, nitidulous above, somewhat paler beneath; petioles 0.4–0.6 cm. long; inflorescence aggregate dichasial, terminal, about equalling or somewhat shorter than the subtending leaves, bearing many small, red or flesh-colored flowers; peduncle minutely puberulent-papillate to glabrate; pedicels 0.2–0.3 cm. long, papillate or infrequently minutely and sparsely puberulent-papillate; bracts ovate, 0.1–0.25 cm. long, scarious; calyx-lobes ovate, acute to obtuse, 0.18–0.3 cm. long, scarious, minutely papillate to essentially glabrous without, the alternate squamellae in groups of 2–4; corolla-tube 0.15–0.2 cm. long, about 0.12–0.15 cm. in diameter at the base and 0.18–0.2 cm. in diameter at the orifice, glabrous without, glabrous or very indistinctly papillate within, the lobes oblong-ligular, obtuse, 0.4–0.5 cm. long, widely spreading, glabrous within and without, the margin frequently minutely and sparsely ciliolate; staminal filaments 0.3–0.32 cm. long, exappendiculate, agglutinated to the style, the anthers 0.25–0.3 cm. long, wholly exserted, glabrous; ovary apocarpous, ovoid, about 0.07 cm. long, minutely puberulent to essentially glabrous; stigma 0.1–0.13 cm. long; style 0.25–0.3 cm. long; nectaries about equalling the ovary; follicles relatively slender, acuminate, somewhat flexuose, reflexed-divaricate, more or

less falcate, 14–19 cm. long, glabrous; seeds 0.9–1.0 cm. long, the pale tawny coma 1.8–2.0 cm. long.

Porto Rico: prope Humacao in fruticetis litoralibus ad "Candelero," Sept. 29, 1886, *Sintenis 5195* (B, type, MBG, photograph and analytical drawings); Sierra de Naguabo ad Rio Blanco, in silv. prim., Sept. 5, 1886, *Sintenis 5357* (B, Bx, S); prope Jabucoa, in sylv. prim. mont. "Guayava," ad "La Pandura," Oct. 12, 1886, *Sintenis 5306* (B); prope Aybonito in Barrio del Pasto, Febr. 25, 1885, *Sintenis 2866* (B, US); Maricao, in sylvis montis "Alegrillo," Nov. 26, 1884, *Sintenis 273* (B, M, S, US); Sa. de Luquillo, in monte Jimenes, July, 1885, *Sintenis 1622* (B, D, FM, NY, US); Playa de Humacao in fruticetis paludosis, June, 1881, *Eggers 438* (B, BB, Bx, D); pr. Mayaguez, 1875, *Krug 709* (B); pr. Ciales in fruticetis ad "Torrecilla," May 9, 1887, *Sintenis 6823* (B); prope Bayamon in fruticetis, Oct., 1887, *Stahl 743* (B); Luquillo Mountains, July 14, 1902, *Wilson 214* (B, NY); data incomplete, *Wydler 209* (B, DC, NY); Sierra de Luquillo, 1854, *Blauner 181* (DC); Rio Piedras, May 7, 1912, *Johnston 357* (NY).

46. Forsteronia corymbosa (Jacq.) G. F. W. Meyer, Fl. Esseq. 133. 1818; A. DC. in DC. Prodr. **8**: 437. 1844; K. Sch. in Engl. & Prantl, Nat. Pflanzenfam. **4**^{2}: 187. 1895.

Echites corymbosa Jacq. Enum. Pl. Carib. 13. 1760; Select. Stirp. Am. Hist. **1**: 34; **2**: *pl. 30.* 1763.

Periploca umbellata Aubl. Hist. Pl. Gui. Fr. **1**: 273. 1775, fide Urban.

Parsonsia corymbosa (Jacq.) R. Br. Mem. Wern. Soc. **1**: 65. 1811.

Thyrsanthus corymbosus (Jacq.) Miers, Apoc. So. Am. 97. 1878.

Stems relatively stout, glabrous or essentially so, rather inconspicuously lenticellate when fully mature; leaves opposite petiolate, obovate to broadly oval, apex obtuse or rounded to very shortly and abruptly submucronulate-acuminate, base broadly obtuse, 3–7 cm. long, 1.0–3.5 cm. broad, coriaceous, eglandular, margins somewhat revolute upon desiccation, secondary venation arcuate, relatively distant, glabrous and nitidulous above, beneath paler, glabrous, or very minutely and inconspicuously barbellate in the axils of the midrib; petioles 0.3–1.1 cm. long; inflorescence aggregate dichasial, terminal, about equalling or somewhat shorter than the subtending leaves, bearing many small, red, or infrequently flesh-colored flowers; primary peduncle minutely and rather irregularly puberulent-papillate to essentially glabrate, the ultimate

branches determinate, very minutely puberulent-papillate to essentially glabrate; pedicels 0.2–0.5 cm. long, minutely puberulent-papillate to essentially glabrate; bracts ovate to ovate-lanceolate, 0.1–0.38 cm. long, scarious or only slightly foliaceous; calyx-lobes ovate, obtuse, 0.17–0.25 cm. long, scarious, papillate to essentially glabrous without, the alternate squamellae in groups of 2–4; corolla-tube 0.19–0.25 cm. long, about 0.1–0.125 cm. in diameter at the base and 0.125–0.25 cm. in diameter at the orifice, essentially glabrous without and within, the lobes oblong-ligular, 0.4–0.52 cm. long, widely spreading, minutely but definitely papillate within, rarely glabrate; staminal filaments exappendiculate, 0.28–0.35 cm. long, agglutinated to the style, the anthers 0.25–0.32 cm. long, widely exserted, glabrous; ovary apocarpous, ovoid, about 0.08 cm. long, minutely puberulent to essentially glabrous; stigma 0.07–0.1 cm. long; style 0.3 cm. long; nectaries about equalling the ovary; follicles relatively short and stout, sharply divaricate, rigid and nearly rectilinear, not acuminate, 11–14 cm. long, glabrous when fully mature; seeds 0.65–0.7 cm. long, the pale tawny coma 1.9–2.1 cm. long.

CUBA: HAVANA: in rupibus calcareis ad flum. Cojimar, June 14, 1914, *Ekman 1355* (S); MATANZAS: prope Mantanzas, 1849, *Rugel 343* (B, NY); SANTA CLARA: Calicita, July 24, 1895, *Combs 524* (B, FM, MBG, NY); Soledad, Cienfuegos, climbing on trees, Nov. 6, 1928, *Jack 6614* (AA, FM, S); PINAR DEL RIO: Bay of Mariel, Sept. 21, 1910, *Britton & Earle 7652* (FM, NY); CAMAGUEY; vicinity of Tiffin, Oct. 30–31, 1909, *Shafer 2872* (NY, US); ORIENTE: Yateras et Mt. Libanon, May, 1844, *Linden 1822* (B, Bx, D); along Gibara Carretera, north of Holguin, April 18, 1909, *Shafer 1447* (B, NY, US); Florida, in mont. sup. Daiquiri, alt. 750 m., June 28–29, 1914, *Ekman 1548* (S); Sabana Miranda prope Bayate ad margin. "savannas," July 11, 1914, *Ekman 1937* (S); Sierra de Nipe ad Rio Piedra ad marg. sylvae, Oct. 4, 1919, *Ekman 9827* (S); Baracoa, in collibus, Jan. 8, 1915, *Ekman 4151* (S); data incomplete, *Wright 398* (B, Bx, Camb., D, MBG, NY, S).

HISPANIOLA: HAITI: Dep. du Sud, inter Cabaillon et Aux Cayes, Sept. 7, 1917, *Ekman 847* (S); wooded hill, alt. 650 m., île La Gonave, July 28, 1927, *Ekman 8730* (B, S); in Morne Coudré, Massif du Nord, Marmelade, alt. 750 m., May 29, 1927, *Ekman 8289* (B, US); Schattige Stellen, Passe David, Gonaives, May, 1900, *Buch 339* (B); prope Terreneuve, July, 1899, *Buch 176* (B); twining on shrub, trail north of "Digue Puits," vicinity of La Vallé, Tortue Island, May 3–10, 1929, *Leonard & Leonard 15543* (MBG, US); sommet du Morne Bellevue, ouest de Nancivet, alt. 600–700 m., Aug. 31, 1908, *Christ 1937* (B); prope Pétionville, alt. 400–500 m., Aug. 17, 1891, *Picarda 813* (B); prope Payan ad viam ad fuentem

versus, Jan., 1891, *Picarda 154* (B); SANTO DOMINGO: Sierra del Palo Quemado, alt. 500 m., May 10, 1887, *Eggers 1894* (B, D, M); in sylva montis, "Izabel de la Torée," alt. 300 m., July 30, 1887, *Eggers 1894b* (B); prope Puerto-Plata, July 2, 1887, *Eggers 1894c* (B); in pineto, prope Constanza, alt. 1190 m., July, 1910, *Tuerckheim 3476* (B, D, M, NY); prope Maniel de Ocoa, alt. 300 m., Oct., 1910, *Tuerckheim 3636* (B, D, M, NY); semi-arid pine region, Moncion, Prov. Monte Cristy, alt. 375 m., Oct. 9, 1929, *Valeur 226* (D, MBG, NY, US); prope Barahona, July, 1910, *Fuertes 410* (B, D, FM, MBG, NY, S, US).

An interesting account of the aspect of these plants is recorded by Christ: "Liane très-longue, ligneuse, affectionnant, semble-t-il, de Manguier, sur les branches les plus élevés duquel elle s'étale. Fleurs rouges foncés, nombreux, ne poussant qu'à la partie superieure de la tige étalée. Les fruits ont une double position: au début relevés l'un vers l'autre et se touchant aux extremités. À maturité écartés completement l'un de l'autre, sur une même ligne horizontal."

Ekman 8730 bears flowers described as "pallide carneis" by the collector. These plants may eventually be found to represent a color form. The typical color of the flowers is dark red. The dried specimens show the flowers to be much paler than all others examined.

Subgen. II. PTERANTHERA Woodson, subgen. nov.

Stamen filaments bearing a conspicuous, alate, membranaceous appendage just below the insertion of the anther. *Spp. 47–48.*

KEY TO THE SPECIES

a. Inflorescence glabrous or essentially so; leaves firmly membranaceous, the margin not revolute in desiccation, 7–15 cm. long............ *47. F. refracta*

aa. Inflorescence minutely puberulent to puberulent-papillate, at least in part; leaves coriaceous, the margin somewhat revolute in desiccation, 6–7 cm. long.. *48. F. fallax*

47. Forsteronia refracta Muell.-Arg. in Mart. Fl. Bras. 6^1: 97. 1860; Miers, Apoc. So. Am. 244. *pl. 35B.* 1878.

Forsteronia floribunda Muell.-Arg. loc. cit. 96. 1860, not G. F. W. Meyer.

Forsteronia lagoënsis Muell.-Arg. in Warming, Kjoeb. Vidensk. Meddel. 108. 1869.

Thyrsanthus myrianthus Miers, loc. cit. 105. 1878.

Forsteronia refracta Muell.-Arg. var. *contracta* Taub. in Engl. Bot. Jahrb. **21**: 448. 1896.

Stems relatively stout, glabrous, rather inconspicuously lenticellate; leaves opposite or infrequently ternate, shortly petiolate, rather narrowly elliptic-oblanceolate to broadly oval, apex shortly and abruptly acuminate to acute, infrequently obtuse upon older specimens, 7–15 cm. long, 2.5–8.0 cm. broad, firmly membranaceous, above glabrous, inconspicuously glandular at the base of the midrib, glabrous beneath, or very minutely and sparsely ciliolate in the axils of the midrib; petioles 0.2–0.9 cm. long; inflorescence laxly thyrsiform, terminal, usually greatly surpassing the subtending leaves, occasionally somewhat shorter, bearing many small, white flowers; primary peduncle glabrous, ultimate branches glabrous, determinate; pedicels 0.17–0.35 cm. long, glabrous; bracts ovate to ovate-lanceolate, deciduous, 0.05–0.2 cm. long, scarious; calyx-lobes broadly ovate, acute to obtuse, 0.09–0.11 cm. long, scarious, glabrous without, the squamellae 3–4 times as many as the lobes, regularly and indefinitely distributed; corolla-tube 0.1–0.12 cm. long, about 0.05–0.07 cm. in diameter at the base and 0.2–0.225 cm. in diameter at the orifice, glabrous without, or essentially so, puberulent-papillate within, the lobes ovate, 0.2–0.28 cm. long, widely spreading, densely and conspicuously pilosulose within; staminal filaments 0.1–0.12 cm. long, distinctly bi-alate toward the insertion of the anthers, the anthers about 0.1 cm. long, glabrous, exserted; ovary apocarpous, ovoid, about 0.07 cm. long, glabrous, or very minutely and sparsely pilosulose toward the tips; stigma 0.05–0.08 cm. long; style about 0.2 cm. long; follicles relatively long and stout, conspicuously and rather distantly moniliform, relatively rigid and subparallel, occasionally somewhat divaricate, 28–52 cm. long, glabrous; seeds 2.7–2.9 cm. long, the brilliant tawny coma 5.0–5.2 cm. long.

VENEZUELA: MERIDA: prope Coloniam Tovar, 1854–5, *Fendler 2381* (MBG).

BRAZIL: PARA: understory in cut-over wood, Japanese Colony, Thomé Assu, Districto Acara, July 16, 1931, *Mexia 5915 in part* (MBG); RIO DE JANEIRO: Theresopolis, alt. 900 m., Oct. 11, 1929, *Brade 9672* (B); data incomplete: *Glaziou 7756* (B); *Glaziou 2091* (Bx); MINAS GERAES: in shade of forest, road to São

Miguel, alt. 710 m., frequent, Oct. 29, 1930, *Mexia 5234* (MBG); Lagôa Santa, Aug. 29, 1864, *Engle s.n.* (C); data incomplete: *Lhotzky s.n.* (B); *Araujo 11935* (B); *Gardner 5012* (B, DC, NY, US); PARANA: in silva primaeva, Porto de Cima, Dec. 23, 1908, *Dusen 7445* (Bx, D, MBG, NY, US); DATA INCOMPLETE: *Sellow s.n.* (B, Bx, COTYPE, MBG, photograph and analytical drawings).

PARAGUAY: in altaplanitie et declivibus "Sierra de Amambay," Oct., 1907, *Rojas 10652* (B); in regione fluminis, Alto Parana, 1909–10, *Fiebrig 5380* (M).

ARGENTINA: MISIONES: San Pedro, Rosados de los Indios, Nov. 9, 1886, *Niederlein 1965* (B).

Considerable doubt remains concerning the identity of *Fendler 2381* from Venezuela and *Mexia 5915* from the state of Para, Brazil. Both specimens bear fruit, without flowers. In either case the fruit corresponds closely to that of authentic specimens of *F. refracta;* but the occurrence of the species in Venezuela and northern Brazil remains to be verified by more perfect records.

48. Forsteronia fallax Taub. in herb.

Fruticosa volubilis; ramulis sat crassiusculis glaberrimis maturitate conspicue lenticellatis; foliis oppositis brevissime petiolatis ellipticis apice obtusis rotundatisve basi obtusis subcuneatis 6–7 cm. longis 2.0–3.1 cm. latis coriaceis vel subcoriaceis margine post exsiccationem paulo revolutis glaberrimis nervo medio supra inconspicue glanduligero; petiolis 0.3–0.35 cm. longis; inflorescentiis laxe thyrsiformi-paniculatis terminalibus folia superantibus flores parvas multas albidas gerentibus; pedunculo minute puberulo-papillato vel basi glabriusculo ramulis minute puberulo-papillatis; pedicellis 0.07–0.1 cm. longis minute puberulo-papillatis; bracteis ovatis vel ovato-lanceolatis deciduis 0.08–0.15 cm. longis scariaceis; calycis laciniis late ovato-deltoideis obtusis rotundatisve ca. 0.08 cm. longis scariaceis minutissime irregulariterque puberulo-papillatis squamellis alternatis solitariis minutissimis; corollae tubo ca. 0.07 cm. longo basi ca. 0.04 cm. diametro metiente faucibus ca. 0.15–0.17 cm. diametro metientibus extus glabris glabriusculisve intus minute villosulis lobis ovatis ca. 0.17 cm. longis patulis extus glabriusculis intus dense conspicueque pilosulis; filamentis staminum ca. 0.08 cm. longis apice appendiculatis; antheris ca. 0.8 cm. longis glabris exsertis; ovario oblongo-ovoideo apocarpo ca. 0.04 cm. longo minute papillato; stigmate

0.05–0.07 cm. longo; stylo ca. 0.01 cm. longo; nectariis ovario paululo brevioribus; folliculis ignotis.

Stems relatively stout, glabrous, conspicuously lenticellate when fully mature; leaves opposite, very shortly petiolate, elliptic, apex obtuse or rounded, base obtuse, subcuneate, 6–7 cm. long, 2.0–3.1 cm. broad, coriaceous or subcoriaceous, margin somewhat revolute after desiccation, glabrous throughout, inconspicuously glandular above at the base of the midrib; petioles 0.3–0.35 cm. long; inflorescence laxly thyrsiform-paniculate, terminal, somewhat surpassing the subtending leaves, bearing many small, white flowers; peduncle minutely puberulent-papillate to glabrous below, ultimate branches determinate, minutely puberulent-papillate; pedicels 0.07–0.1 cm. long, minutely puberulent-papillate; bracts ovate or ovate-lanceolate, 0.08–0.15 cm. long, scarious, deciduous; calyx-lobes broadly ovate-deltoid, obtuse or rounded, about 0.08 cm. long, scarious, minutely and irregularly puberulent-papillate without, the squamellae very minute, alternate, solitary; corolla-tube about 0.07 cm. long, about 0.04 cm. in diameter at the base and 0.15–0.17 cm. in diameter at the orifice, essentially glabrous without, minutely villosulose within, the lobes ovate, about 0.17 cm. long, widely spreading, essentially glabrous without, densely and conspicuously pilosulose within; staminal filaments about 0.08 cm. long, appendiculate above, the anthers about 0.08 cm. long, glabrous, wholly exserted; ovary oblong-ovoid, apocarpous, about 0.04 cm. long, minutely papillate; stigma 0.05–0.07 cm. long; style about 0.01 cm. long; nectaries somewhat shorter than the ovary; follicles unknown.

BRAZIL: RIO DE JANEIRO: data incomplete, *Glaziou 4080* (B, TYPE, MBG, photograph and analytical drawings).

EXCLUDED SPECIES

Forsteronia panniculata Casar. ex K. Sch. in Mart. Fl. Bras. **6**^{6}: 200. 1889, nom. nud. in synon. = **Molopanthera paniculata** Turcz. Bull. Soc. Nat. Mosc. **21**^{1}: 581. 1848.

Forsteronia Pavonii A. DC. in DC. Prodr. **8**: 438. 1844 = **Apocynum cannabinum** L. var. **glaberrimum** A. DC. loc. cit. 439. 1844.

The type specimen of *Forsteronia Pavonii*, an unnumbered collection by Pavon in the herbarium of Boissier at Geneva, shows itself typical of the glabrous variety of the frequent and widespread *Apocynum cannabinum* L. of temperate North America. Pavon's collection label is without locality. Just how the plant became confused with the tropical genus *Forsteronia* may be explained variously. The ultimate reason, naturally, is the failure of de Candolle to observe the conspicuous, sagittate enations at the base of the corolla-tube alternating with the staminal filaments, easily perceived from a simple dissection.

The accidental inclusion of the plant, perhaps from the collections of another botanist from temperate North America, with those of Pavon from Mexico and Peru may have completed the circumstantial evidence misplacing the plant systematically, for it is quite true that a superficial similarity exists between *Apocynum* and *Forsteronia* in the thyrsiform inflorescence and small flowers of either. A photograph accompanied by analytical drawings of the type specimen has been incorporated in the herbarium of the Missouri Botanical Garden. Miers (Apoc. So. Am. 243. 1878), without easy access to Pavon's specimen, erroneously referred to this species *Spruce 4908*, more correctly referable to *F. tarapotensis* K. Sch. (cf. p. (230)).

VI. Secondatia A. DC.

Secondatia A. DC. in DC. Prodr. **8**: 445. 1844; Muell.-Arg. in Mart. Fl. Bras. **6**[1]: 107. 1860; Benth. & Hook. Gen. Pl. **2**: 723. 1876; Miers, Apoc. So. Am. 226. 1878; K. Sch. in Engl. & Prantl, Nat. Pflanzenfam. **4**[2]: 165. 1895.

Orthechites Urb. Symb. Ant. **6**: 36. 1909.

Lactescent, fruticose or suffruticose lianas. Stems volubile (or erect in *S. Macnabii* ?), terete, the branches opposite or alternate above. Leaves opposite, petiolate, entire, penninerved, eglandular; nodes minutely appendiculate. Inflorescence terminal, or both terminal and lateral, thyrsiform, bracteate, several-flowered. Calyx 5-parted, the lobes equal to subequal, cleft nearly to the receptacle, imbricated, bearing within

solitary, or rarely paired, alternate squamellae. Corolla salverform, the tube straight, exappendiculate within, the limb actinomorphic, 5-parted, dextrorsely convolute. Stamens 5, the anthers connivent and agglutinated to the stigma, consisting of 2 parallel, linear sporangia borne ventrally near the apex of an enlarged, sagittate, narrowly 2-lobed, peltate connective; pollen granular; filaments short. Carpels 2, united at the apex by a common stylar shaft surmounted by the fusiform stigma (sessile in *S. floribunda* and *S. Duckei*); ovules numerous, several-seriate, borne upon an axile, binate placenta. Nectaries 5, more or less concrescent at the base. Follicles 2, apocarpous, broadly fusiform, dehiscent along the ventral suture, containing many dry, truncate, apically comose seeds.

Type species: *Secondatia densiflora* A. DC. in DC. Prodr. **8**: 445. 1844.

KEY TO THE SPECIES

a. Corolla-tube 0.5–0.82 cm. long; species of South America.
  b. Stigma supported by a short style; nectaries nearly equalling the ovary.
    c. Corolla-lobes obliquely obovate, shorter than the tube.
      d. Anthers minutely puberulent dorsally.............. *1. S. densiflora*
      dd. Anthers glabrous.................................... *2. S. peruviana*
    cc. Corolla-lobes oblong-dolabriform, equalling or slightly surpassing the tube.. *3. S. Schlimiana*
  bb. Stigma sessile; nectaries much shorter than the ovary.
    c. Corolla-lobes obliquely elliptic, 0.7–1.2 cm. long; ovary glabrous.. *4. S. floribunda*
    cc. Corolla-lobes oblong-linear, 2.2–2.5 cm. long; ovary minutely and sparsely puberulent.................................. *5. S. Duckei*
aa. Corolla-tube about 1.5 cm. long; plants of Jamaica............ *6. S. Macnabii*

1. **Secondatia densiflora** A. DC. in DC. Prodr. **8**: 445. 1844; Muell.-Arg. in Mart. Fl. Bras. **6**^{1}: 108. *pl. 32. fig. 2.* 1860; Miers, Apoc. So. Am. 226. *pl. 32.* 1878; K. Sch. in Engl. & Prantl, Nat. Pflanzenfam. **4**^{2}: 165. 1895.

Secondatia densiflora A. DC. β *parvifolia* Muell.-Arg. loc. cit. 1860.

Secondatia densiflora A. DC. var. *paraguariensis* Hassl. in Fedde, Rep. Sp. Nov. **12**: 263. 1913.

Secondatia densiflora A. DC. α *genuina* Muell.-Arg. ex Hassl. loc. cit. 264. 1913, sphalm.

Stems relatively stout, minutely papillate when very young, soon becoming glabrate and conspicuously lenticellate when fully mature; leaves broadly ovate-, obovate-, or oblong-elliptic, apex abruptly subcaudate-acuminate, base broadly obtuse or rounded, 3.5–11.5 cm. long, 1.5–6.5 cm. broad, firmly membranaceous to subcoriaceous, glabrous, essentially concolorous or only slightly paler beneath, the vein-ends immersed and relatively obscure; petioles 0.7–1.5 cm. long; inflorescence subcorymbose, terminal, or infrequently lateral as well, much shorter than the subtending leaves, bearing numerous small, white flowers; pedicels 0.35–0.6 cm. long, greatly accrescent in fruit, minutely papillate or essentially glabrous; bracts ovate or ovate-oblong, 0.1–0.3 cm. long, scarious or only slightly foliaceous; calyx-lobes ovate to ovate-oblong, obtuse, 0.15–0.25 cm. long, scarious, minutely papillate to essentially glabrous; corolla salverform, glabrous without, the tube 0.65–0.8 cm. long, about 0.1–0.12 cm. in diameter at the base, not conspicuously dilated at the insertion of the stamens, slightly narrowing toward the orifice, densely puberulent within, the lobes obliquely obovate, obtuse, 0.35–0.5 cm. long, glabrous, spreading; stamens inserted at about the lower ¼ of the corolla-tube, the anthers 0.35–0.4 cm. long, minutely puberulent dorsally; stigma 0.175–0.25 cm. long, surmounting a style of about equal length; ovary ovoid, about 0.07 cm. long, glabrous; nectaries concrescent at the base, slightly shorter than the ovary; follicles broadly fusiform, somewhat compressed laterally, 12–13 cm. long, about 2.0–2.5 cm. in greatest diameter, glabrous; seeds about 2 cm. long, the pale tawny coma 3.5–4.0 cm. long.

BRITISH GUIANA: Pirara, etc., 1841–2, *Schomburgk 421* (V); same locality, *Schomburgk 681* (B); data incomplete, *Schomburgk 599* (V, COTYPE); *Schomburgk 665* (D).

DUTCH GUIANA: fluv. Lawa, Oct., 1903, *Versteeg 451* (U).

BRAZIL: PIAUHY: exact locality lacking, 1883, *Netto 46* (US); MINAS GERAES: data incomplete, *Claussen 341* (B, COTYPE); RIO DE JANEIRO: Sumidouro, 1845, *Pohl s.n.* (V); data incomplete, *Sellow s.n.* (Bx); GOYAZ: data incomplete, *Gardner 3325* (B, D, COTYPE, NY, V); MATTO GROSSO: Cuyaba, Nov. 21, 1893, *Malme 1118* (B, D, S); Cuyaba, 1834, *Manso s.n.* (Bx); Rio Arimos, margins do rio, Dec., 1914, *Kuhlmann 1234* (US); Uferwald am oberen Paranatinga, Sept. 28, 1899, *Pilger 799* (B); SÃO PAULO: Rib. da Lagôa, Rio Feio, cerrado, Nov., 1905, *Edwall*

11242 (B); PARA: campos do Ariramba, prope flum. Jaramacaru, Dec. 2, 1910, *Ducke 21622* (B, US); Obidos, silva secundaria, Dec. 11, 1903, *Ducke 21641* (B); AMAZONAS: in Fellsgruppen des campo bei der Serra de Pracama, Rio Branco, Jan., 1909, *Ule 7940* (B); silva humosa non inundabili, São Paulo de Olivença, Aug. 19, 1929, *Ducke 22430* (B); DATA INCOMPLETE: *Riedel s.n.* (B, BB, NY, V); *Pohl 1845* (V); *Martius 967* (B, D, TYPE, M, NY, V, MBG, photograph and analytical drawings); *Glaziou 11179* (B).

BOLIVIA: SANTA CRUZ: Bañado del Rio Moreno, Prov. Cercado, alt. 450 m., Oct. 28, 1925, *Steinbach 7301* (B, D, FM, MBG, U); Bañado del Rio Perdiz, Prov. Sara, alt. 450 m., Oct. 30, 1916, *Steinbach 3113* (B, D); LA PAZ: Millaguaya, alt. 1000 m., Dec., 1917, *Buchtien 4371* (B, US); BENI: Riberalta, Sept. 28, 1923, *Kuhlmann 21873* (B, U, US).

PARAGUAY: in altaplanitie "Sierra de Amambay," Nov., 1912, *Hassler 11420* (D, V).

2. Secondatia peruviana Poeppig, Nov. Gen. **3**: 71. *pl. 281.* 1845; Miers, Apoc. So. Am. 228. 1878; K. Sch. in Engl. & Prantl, Nat. Pflanzenfam. **4²**: 165. 1895.

Stems relatively slender, glabrous or essentially so, conspicuously lenticellate when fully mature; leaves ovate-elliptic, apex abruptly subcaudate-acuminate, base broadly obtuse or rounded, 5.2–9.5 cm. long, 2.2–5.0 cm. broad, membranaceous, glabrous, essentially concolorous or only slightly paler beneath, the vein-ends immersed and relatively obscure; petioles 0.7–1.5 cm. long; inflorescence subcorymbose, both terminal and lateral, much shorter than the subtending leaves, bearing numerous small, white flowers; pedicels 0.2–0.5 cm. long, glabrous or very minutely papillate; bracts ovate, 0.1–0.2 cm. long, scarious; calyx-lobes ovate, acute to obtuse, 0.1–0.15 cm. long, scarious, glabrous or very minutely ciliolate; corolla salverform, glabrous without, the tube 0.7–0.75 cm. long, about 0.125–0.15 cm. in diameter at the base, not conspicuously dilated at the insertion of the stamens, slightly narrowing toward the orifice, puberulent within, the lobes obliquely obovate, obtuse or rounded, 0.4–0.55 cm. long, glabrous, spreading; stamens inserted at about the lower ¼ of the corolla-tube, the anthers 0.4–0.45 cm. long, glabrous; stigma 0.18–0.2 cm. long, supported by a style of about equal length; ovary ovoid, somewhat less than 0.1 cm. long, glabrous; nectaries concrescent at the base, slightly shorter than the ovary; mature follicles unknown.

PERU: LORETO: Cuchero et in sylvis montanis ad Pampayaro, Dec., 1829, *Poeppig 1582* (B, BB, MBG, V, TYPE); Stromgebiet des Maranon, Santiago-Mündung, Oct. 24, 1924, *Tessmann 4359* (B, D).

The immature fruit of this species is figured by Poeppig (loc. cit. *pl. 281. fig. 9.* 1845) as broadly ovoid, and sharply divaricate, and described as about 1 inch in length. Bentham and Hooker (Gen. Pl. **2**: 723. 1876) favored the rejection of *S. peruviana* from the genus *Secondatia* upon this evidence, believing the fruit of the genus to be narrowly linear. The only follicles known of the type species (*Martius 967* in Herb. Vindob. and *Manso s.n.* in Herb. Brux.), however, are broadly fusiform, and are suggested plainly by Poeppig's drawings of the immature mericarps of *S. peruviana.* It appears wholly probable that the fruits of *S. densiflora* and *S. peruviana* are no more than specifically distinct when mature.

3. **Secondatia Schlimiana** Muell.-Arg. Linnaea **30**: 416. 1860; Miers, Apoc. So. Am. 227. 1878.

Stems relatively stout, minutely puberulent-papillate when very young, soon becoming glabrate and conspicuously lenticellate when fully mature; leaves broadly oval to ovate-elliptic, apex abruptly subcaudate-acuminate, base broadly obtuse or rounded, 3.7–6.0 cm. long, 1.7–3.0 cm. broad, membranaceous, glabrous, essentially concolorous or only slightly paler beneath, the vein-ends immersed and relatively obscure; petioles 0.7–1.2 cm. long; inflorescence subcorymbose, terminal, or lateral as well, much shorter than the subtending leaves, bearing numerous small, white flowers; pedicels 0.2–0.4 cm. long, minutely puberulent-papillate to essentially glabrous; bracts ovate-oblong, 0.1–0.2 cm. long, scarious or only slightly foliaceous; calyx-lobes ovate-suborbicular, broadly obtuse or rounded, 0.15–0.2 cm. long, minutely puberulent-papillate without, scarious; corolla salverform, glabrous without, the tube 0.7–0.8 cm. long, about 0.175 cm. in diameter at the base, not conspicuously dilated at the insertion of the stamens, slightly narrowing toward the orifice, puberulent within, the lobes oblong-dolabriform, obtuse or rounded, 0.9–1.0 cm. long, glabrous, reflexed or widely spreading; stamens inserted at about the lower 1/4 of the corolla-tube, the anthers 0.4–0.45 cm. long,

minutely puberulent dorsally; stigma 0.17–0.2 cm. long, supported by a style of about equal length; ovary ovoid, about 0.1 cm. long, glabrous; nectaries concrescent at the base, about as long as the ovary; follicles unknown.

COLOMBIA: SANTANDER DEL NORTE: Ocana, alt. 4000 pp., May, 1846–52, *Schlim 510* (BB, TYPE, BM, Bx, D, MBG, photograph and analytical drawings).

4. **Secondatia floribunda** A. DC. in DC. Prodr. 8: 446. 1844; Muell.-Arg. in Mart. Fl. Bras. 6^1: 109. 1860; Miers, Apoc. So. Am. 227. 1878.

Secondatia foliosa A. DC. loc. cit. 1844; Muell.-Arg. loc. cit. *pl. 32. fig. 1.* 1860; Miers, loc. cit. 1878; K. Sch. in Engl. & Prantl, Nat. Pflanzenfam. 4^2: 165. 1895.

Secondatia foliosa A. DC. β. *Gardneri* A. DC. loc. cit. 1844; Muell.-Arg. loc. cit. 1860.

Secondatia foliosa A. DC. γ. *petiolaris* Muell.-Arg. loc. cit. 1860.

Secondatia foliosa A. DC. δ. *lanceolata* Muell.-Arg. loc. cit. 1860.

Stems relatively slender, glabrous or essentially so, conspicuously lenticellate when fully mature; leaves ovate-elliptic to broadly oval, abruptly acuminate to subcaudate-acuminate, base broadly obtuse or rounded, 3–9 cm. long, 1.5–4.5 cm. broad, firmly membranaceous to subcoriaceous, glabrous, conspicuously pallid beneath, the vein-ends very conspicuous and reticulate; petioles 0.4–1.4 cm. long; inflorescence subcorymbose, terminal, or lateral as well, somewhat shorter than the subtending leaves, bearing numerous small, white flowers; pedicels 0.6–0.8 cm. long, glabrous or very minutely puberulent-papillate; bracts ovate to ovate-lanceolate, 0.075–0.125 cm. long; calyx-lobes ovate, acute, 0.15–0.2 cm. long, scarious, minutely puberulent-papillate to essentially glabrous without; corolla salverform, glabrous without, the tube 0.55–0.65 cm. long, about 0.1–0.125 cm. in diameter at the base, conspicuously dilated at the insertion of the stamens, slightly narrowing toward the orifice, the lobes obliquely elliptic, broadly acute, 0.7–1.2 cm. long, glabrous, widely spreading; stamens inserted barely above the base of the corolla-tube, the anthers 0.33–0.35 cm. long, long-acuminate, minutely puberulent dorsally; stigma

sessile, 0.15–0.18 cm. long; ovary ovoid, about 0.125 cm. long, glabrous or very minutely papillate; nectaries concrescent at the base, much shorter than the ovary; follicles unknown.

Brazil: ceara: data incomplete, *Gardner 1762* (NY, US, V); bahia: forêts, Jacobina, date lacking, *Blanchet 3370* (B, Bx, DC, type, NY, V, MBG, photograph and analytical drawings); Jacobina, date lacking, *Blanchet 3635* (DC, M, V); Capão bei Sincora, Nov., 1906, *Ule 7118* (B); minas geraes: Vespasiano, Nov., 1915, *Hoehne 6251* (B); cut-over woods on hill, Fazenda de Jose Alexandre, alt. 725 m., Nov. 20, 1930, *Mexia 5334a* (MBG); data incomplete, *Claussen s.n.* (V); Catingas, locis aridis ad fl. Rio Fermozo, Sept., year lacking, *Martius s.n.* (M); Lagôa Santa, Oct. 1864, *Warming s.n.* (C, NY); data incomplete: *Glaziou 21720* (B, Bx); *Glaziou 12941* (B, Bx); *Pohl 1846* (B, V).

Secondatia foliosa differs from the type specimen of *S. floribunda* only in slight and insignificant differences in dimension of the flowers and foliage. It appears significant that both were collected in the vicinity of Jacobina, state of Bahia, the type specimens being *Blanchet 3635* and *Blanchet 3370* respectively. One can scarcely restrain the opinion that varietal or even specific distinctions were frequently made by A. de Candolle and Mueller upon characteristics which are usually interpreted as individual variations among a wide selection of study specimens.

5. **Secondatia Duckei** Mgf. Notizblatt **11**: 338. 1932.

Stems relatively stout, glabrous, conspicuously lenticellate when fully mature; leaves broadly ovate-lanceolate to oblong-elliptic, apex rather gradually acuminate to subcaudate-acuminate, base broadly obtuse or rounded, 7.5–12.5 cm. long, 3.0–5.2 cm. broad, firmly membranaceous to subcoriaceous, glabrous, conspicuously pallid beneath; petioles 0.8–1.0 cm. long; inflorescence much shorter than the subtending leaves, lax and relatively few-flowered; pedicels 0.4–0.6 cm. long, glabrous; bracts very minute; calyx-lobes ovate-trigonal, acute, 0.1–0.12 cm. long, glabrous, scarious; corolla salverform, glabrous without, the tube 0.8–0.82 cm. long, somewhat inflated at the insertion of the stamens, narrowing toward the orifice, puberulent within, the lobes linear or oblong-linear, 2.2–2.5 cm. long, glabrous, spreading; stamens inserted near the base of the corolla-tube, the anthers 0.43–0.45 cm. long, minutely puberulent dorsally; stigma sessile, 0.15–0.17 cm. long; ovary ovoid,

0.1–0.12 cm. long, sparsely and minutely puberulent; nectaries concrescent at the base, much shorter than the ovary; follicles unknown.

BRAZIL: AMAZONAS: Rio Negro super confluentiam flum. Curicuriary, silva non inundabili, Nov. 24, 1929, *Ducke 22432* (B, TYPE, US, MBG, photograph and analytical drawings).

6. **Secondatia Macnabii** (Urb.) Woodson, Ann. Mo. Bot. Gard. **19**: 385. 1932.

Orthechites Macnabii Urb. Symb. Ant. **6**: 37. 1909.

Stems relatively stout, glabrous or essentially so, inconspicuously lenticellate when fully mature; leaves lanceolate to oblong-lanceolate, apex acuminate, base acute to obtuse, 5–7 cm. long, 1.3–2.3 cm. broad, firmly membranaceous or chartaceous, glabrous; petioles 0.3–0.4 cm. long; inflorescence subcorymbose, terminal, bearing relatively few (3–6) small, white flowers; pedicels 0.3–0.4 cm. long, glabrous; bracts minute; calyx-lobes 0.2 cm. long, acute, minutely ciliolate; corolla salverform, glabrous without, the tube about 1.5 cm. long, about 0.15 cm. in diameter at the base, puberulent within, the lobes obliquely elliptic, acute, 0.7–0.8 cm. long, spreading; stamens inserted somewhat below midway within the corolla-tube, the anthers linear-lanceolate; stigma about 0.05 cm. long; ovary ovoid, glabrous; nectaries much shorter than the ovary; follicles unknown.

JAMAICA: exact locality and date lacking, *Macnab s.n.* (B, drawing of TYPE).

It has been impossible to examine the type specimen of this species, which was sent with other specimens from the herbarium at Edinburgh to the British Museum (Natural History) for examination by Fawcett and Rendle and has evidently been lost or destroyed. The drawing, together with Urban's description, presents no valid reason for not including the species with *Secondatia,* where it constitutes an element no more foreign to the type species than do *S. floribunda* and *S. Duckei.* For a relatively small island which has been known to botanical collectors for such a long time, Jamaica has produced a surprising number of mysterious species of plants known from single, insufficiently recorded specimens.

EXCLUDED SPECIES

Secondatia difformis (Walt.) Benth. & Hook. ex Miers, Apoc. So. Am. 99. 1878, in synon. (*Echites difformis* Walt. Fl. Carol. 98. 1788) = **Trachelospermum difforme** (Walt.) A. Gray, Syn. Fl. N. Am. **2**: 84. 1878.

Secondatia ferruginea (A. Rich.) Miers, loc. cit. 227. 1878 (*Echites ferruginea* A. Rich. in Sagra, Fl. Cub. **2**: 92. 1853) = **Angadenia Lindeniana** (Muell.-Arg.) Miers, loc. cit. 180. 1878 (*Rhabdadenia Lindeniana* Muell.-Arg. Linnaea **30**: 438. 1860).

Secondatia stans (A. Gray) Standl. Contr. U. S. Nat. Herb. **23**: 1165. 1924 (*Trachelospermum stans* A. Gray, Proc. Am. Acad. **21**: 394. 1886) = **Mandevilla foliosa** (Muell.-Arg.) Hemsl. Biol. Centr.-Am. Bot. **2**: 316. 1882 (*Amblyanthera foliosa* Muell.-Arg. Linnaea **30**: 427. 1860).

VII. Trachelospermum Lem.

Trachelospermum Lem. Jard. Fleur. **1**: *pl. 61.* 1851; A. Gray, Syn. Fl. N. Am. **2**: 84. 1878.

Lactescent, suffruticose lianas. Stems volubile, terete, the branches alternate, occasionally becoming opposite after injury. Leaves opposite, petiolate, entire, penninerved, eglandular; nodes very inconspicuously stipulate. Inflorescence lateral and alternate in our species, thyrsiform, aggregate dichasial in our species. Calyx 5-parted, the lobes essentially equal, cleft nearly to the receptacle, imbricated, bearing within alternate pairs of minute, glandular squamellae in our species. Corolla salverform, in our species the tube relatively short, slightly dilated above the insertion of the stamens, exappendiculate within, the orifice not annulate, the limb actinomorphic, 5-parted, dextrorsely convolute. Stamens 5, the anthers included or the tips barely exserted in our species, connivent and agglutinated to the stigma, consisting of 2 parallel, uniformly fertile sporangia borne ventrally near the apex of an enlarged, sagittate, peltate connective; pollen granular; filaments free from the style. Carpels 2, apocarpous, united at the apex by a common style surmounted by the capitate stigma; ovules many, several-seriate, borne upon an axile, binate placenta. Nectaries 5, essentially separate or somewhat concrescent at the

base. Follicles 2, apocarpous, terete and relatively slender in our species, dehiscing along the ventral suture, containing many dry, truncate, apically comose seeds.

Type species: *Trachelospermum jasminoides* (Lindl.) Lem. Jard. Fleur. **1:** *pl. 61.* 1851.

The genus *Trachelospermum* includes numerous species of southeastern Asia, among which is the type species. In the western hemisphere the genus is represented by a single species, *T. difforme* (Walt.) A. Gray (= *Echites difformis* Walt.). As has already been indicated more briefly (p. (19) *ante*), reasons for placing this species in the Asiatic genus *Trachelospermum* rather than in the tropical American *Secondatia* may be reduced to the consideration that the distribution of *E. difformis* in the southeastern United States has been found in numerous instances to be strongly correlated with southeastern Asiatic affinities not only in another genus of Apocynaceae (*Amsonia,* cf. Woodson, R. E., Jr., Ann. Mo. Bot. Gard. **15**: 388. 1928) but in certain other families of vascular plants as well.

Morphological reasons for assigning the species to *Trachelospermum* rather than to *Secondatia* are found in the fusiform stigma and solitary squamellae of the latter genus. The contrasting capitate or subcapitate stigma and geminate squamellae of *E. difformis,* however, are not characters which are maintained rigidly throughout the Asiatic representation of *Trachelospermum.* As may be inferred from the foregoing considerations, the whole problem boils down to our ignorance of adequate characters to distinguish *Secondatia* and *Trachelospermum* as genera. Should the suspected congenericity of the two be acted upon nomenclatorially, the former name should have to be preserved by reason of priority. Thus a more familiar name would be displaced by one much less generally known, and a fairly large number of new nomenclatorial combinations necessitated. Such radical changes are always deplorable unless activated by conclusive observations, which are yet lacking in the present instance. The preferred course in the situation at hand, then, would appear to be the rather arbitrary retention of both *Trachelospermum* and *Secondatia* for the present,

and the support of Gray's disposition of *Echites difformis* Walt.:

1. **Trachelospermum difforme** (Walt.) A. Gray, Syn. Fl. N. Am. **2**: 85. 1878; Britton & Brown, Illustr. Fl. ed. 1. **3**: 4. *fig. 2899*. 1898; Robinson & Fernald in A. Gray, Man. ed. 7. 662. 1908.

Echites difformis Walt. Fl. Carol. 98. 1788.

Echites puberula Michx. Fl. Bor. Am. **1**: 120. 1803.

Tabernaemontana populifolia Poir. Dict. Suppl. **1**: 276. 1811; A. DC. in DC. Prodr. **8**: 374. 1844.

Echites salicifolia Raf. New Fl. N. Am. **4**: 59. 1836, not Willd.

Forsteronia difformis (Walt.) A. DC. loc. cit. 437. 1844.

Secondatia difformis (Walt.) Benth. in Benth. & Hook. Gen. Pl. **2**: 710. 1876; K. Sch. in Engl. & Prantl, Nat. Pflanzenfam. **4²**: 165. 1895.

Thyrsanthus populifolius (Poir.) Miers, Apoc. So. Am. 99. 1878.

Thyrsanthus difformis (Walt.) Miers, loc. cit. 1878.

Stems relatively slender, glabrous, or minutely and sparsely pilosulose when very young, rather inconspicuously lenticellate when fully mature; leaves opposite, shortly petiolate, elliptic to obovate-elliptic, less frequently elliptic-linear to suborbicular, apex acuminate, occasionally very shortly and abruptly so, base acute to obtuse, occasionally rounded, 2.7–12.0 cm. long, 0.4–7.2 cm. broad, delicately membranaceous, above glabrous or essentially so, beneath softly puberulent to essentially glabrous; petioles 0.1–1.5 cm. long; stipular appendages interpetiolar, minute, flagelliform to narrowly denticulate, several; inflorescence thyrsiform, lateral, alternate, bearing numerous small, pale yellow flowers; peduncle sparsely pilosulose to essentially glabrous, ultimate branches determinate, minutely and sparsely puberulent-papillate to essentially glabrous; pedicels 0.4–0.7 cm. long, minutely puberulent-papillate to nearly glabrate, conspicuously accrescent in fruit; bracts narrowly lanceolate to linear, 0.1–0.5 cm. long, more or less foliaceous; calyx-lobes ovate-lanceolate, long-acuminate, 0.3–0.37 cm. long, only slightly foliaceous, minutely and rather

sparsely pilosulose-barbellate at the tips, otherwise essentially glabrous, the squamellae usually geminate, occasionally accompanied by smaller, supernumerary individuals; corolla salverform or subinfundibuliform, the tube 0.55–0.65 cm. long, about 0.08–0.1 cm. in diameter at the base, slightly constricted at the insertion of the stamens, then somewhat inflated, about 0.2–0.3 cm. in diameter at the orifice, essentially glabrous without, minutely hirtellous within somewhat above the insertion of the stamens, the lobes obliquely obovate, shortly acuminate, 0.3–0.37 cm. long, somewhat spreading to reflexed, glabrous without, minutely and indistinctly papillate to essentially glabrous within; stamens inserted somewhat below midway within the corolla-tube, the filaments 0.1–0.12 cm. long, very minutely tomentulose, the anthers narrowly sagittate, acuminate, acutely auriculate, 0.32–0.45 cm. long, minutely papillate dorsally; ovary ovoid, about 0.7 cm. long, glabrous; stigma subcapitate, broadly oblongoid, 0.08–0.1 cm. long; style 0.25–0.3 cm. long, deciduous at the insertion to the ovary; nectaries compressed-ovoid, separate, much shorter than the ovary; follicles relatively slender, obscurely undulate-articulate or essentially continuous, tortuose to somewhat divaricate, frequently more or less falcate, acuminate, 15–23 cm. long, glabrous; seeds 0.7–1.0 cm. long, the pale yellowish-ashy coma 1.5–1.8 cm. long.

UNITED STATES: DELAWARE: moist thicket, borders of cedar swamp, near Collins Beach, July 6, 1874, *Commons s.n.* (FM, MBG, NY, US); New Castle City, on borders of a cedar swamp, Aug. 23, 1865, *Commons s.n.* (NY, US); VIRGINIA: in fruticetis pr. Portsmouth, June, 1840, *Rugel s.n.* (BB); Virginia Beach, July 3, 1892, *Britton Britton & Vail s.n.* (NY); NORTH CAROLINA: Burgaw, June, 1880, *Hyams s.n.* (MBG); ''middle North Carolina,'' May 28, year lacking, *Ashe 2354* (NY, US); near Gaston, Northampton Co., June 15, 1895, *Ward s.n.* (US); Edenton, Chowan Co., July 29–30, 1898, *Kearney 1874* (US); SOUTH CAROLINA: Aiken, date lacking, *Ravenel s.n.* (FM); near Charleston, 1865, *Stewart s.n.* (FM); Bluffton, date lacking, *Mellichamp s.n.* (NY, US); GEORGIA: edge of Ogeechee River swamp, Burke Co., alt. 145 ft., June 5, 1901, *Harper 794* (MBG, NY, US); Floyd Co., date lacking, *Chapman s.n.* (MBG); Rome, date lacking, *Chapman s.n.* (US); vicinity of Louisville, date lacking, *Hopkins s.n.* (NY); FLORIDA: bank of Apalachicola River, near Chattahoochee, June 16, 1897, *Curtiss 5893* (FM, MBG, US); Iola, date lacking, *Chapman s.n.* (MBG); near Tallahassee, summer, year lacking, *Berg s.n.* (NY); ALABAMA: low wooded banks, Cullman, June, 1891, *Mohr s.n.* (MBG); along A. G. S. R. R., Valley Head, July, 1898, *Ruth 468* (MBG, NY, US); woods,

near Attalla, Etowah Co., June 30, 1897, *Eggert s.n.* (MBG); near Tuscaloosa, date lacking, *Johnson s.n.* (NY); Calera, date lacking, *Everts s.n.* (NY); Pratt Mines, Aug. 16, 1879, *Mohr s.n.* (US); Busby's Ford, Walker Co., Sept. 10, 1879, *Mohr s.n.* (US); Gadsden, 1878, *Vasey s.n.* (FM, US); banks of Alabama River, Chestang's Bluff, Sept. 1, 1879, *Mohr s.n.* (US); Cedar Plains, swampy copses, May 21, 1891, *Mohr & Sudworth s.n.* (US); MISSISSIPPI: Centerville, Aug. 4, 1897, *Tracy 5468* (MBG, NY); Jackson, May 23, 1888, *Tracy s.n.* (NY); Taylorville, Aug. 23, 1903, *Tracy s.n.* (US); Brookhaven, April 25, 1882, *Flint s.n.* (US); field ditch, Forest, May 26, 1925, *Cook s.n.* (US); LOUISIANA: near New Orleans, date lacking, *Ingalls s.n.* (NY); same data, *Drummond s.n.* (Camb.); Atakapas, May, 1883, *Langlois s.n.* (FM); Natchitoches, June 11, 1915, *Palmer 7958* (MBG); East Baton Rouge Par., May 20, 1874, *Joor s.n.* (FM); TEXAS: Polk, Bowie Co., June 13, 1898, *Eggert s.n.* (MBG); near Houston, April, 1842, *Lindheimer s.n.* (MBG); Big Sandy, common in swamp, June 27, 1901, *Reverchon 2558* (MBG); climbing on small trees, Montgomery Co., July 18–21, 1909, *Dixon 491* (FM, NY); Harrisburg, July 14, 1876, *Joor s.n.* (US); ILLINOIS: low woods bordering swamps, Karnak, Pulaski Co., Sept. 23, 1919, *Palmer 16542* (MBG, US); INDIANA: frequent on the high bank of a slough in the "bottoms," about ¾ mi. southeast of Yankeetown, rare, Aug. 13, 1922, *Deam 37581* (NY); TENNESSEE: low woods, Haywood Co., June, 1893, *Bain 428* (NY); Covington, June, 1889, *Byars s.n.* (US); MISSOURI: border of Creve Coeur Lake, St. Louis Co., February, 1931, *Woodson s.n.* (MBG); swamps, Campbell, Sept. 7, 1910, *Bush 6238* (MBG, NY); in Sümpfen, Dunklin Co., July 27–Sept. 26, 1893, *Eggert s.n.* (MBG); swamps, Butler Co., Oct. 17, 1905, *Bush 3742* (MBG, NY, US); between Paragould [Ark.] and Kennett, July 27, 1893, *Eggert s.n.* (FM, MBG, NY, US); low wet woods, Neeleyville, Butler Co., Sept. 16, 1919, *Palmer 16460* (MBG, US); thickets, fence-rows, etc., Kennett, Dunklin Co., June 8, 1930, *Kellogg 15263* (MBG); ARKANSAS: low rocky banks of Ouachita River, near Hot Springs, Garland Co., Oct. 11, 1925, *Palmer 29164* (MBG); thickets along small rocky creek, near Hot Springs, Garland Co., May 9, 1925, *Palmer 27116* (MBG); low woods, Corning, Clay Co., June 24, 1914, *Palmer 6063* (MBG); low open ground, Arkadelphia, Clark Co., June 21, 1915, *Palmer 8089* (MBG); Little Rock, 1881, *Letterman s.n.* (MBG); Arkansas Post, Sept. 24, 1909, *Kellogg s.n.* (MBG); climbing on bushes, Judsonia, June 12, 1877, *Reynolds s.n.* (FM, US); swamps, Moark, Oct. 17, 1905, *Bush 3751* (MBG); Paragould, Sept. 26, 1893, *Eggert s.n.* (MBG); low woods, Greene Co., July 27, Sept. 26, 1893, *Eggert s.n.* (MBG, NY); along Bridge Creek, near McNab, Hempstead Co., Oct. 4, 1923, *Greenman 4316* (MBG); St. Francis Club (w. of Memphis), April 5, 1889, *Trelease s.n.* (MBG); wet sandy ground, Gum Springs, Clark Co., July 21, 1916, *Palmer 10537* (MBG); Conway, May 15, 1923, *Wheeler s.n.* (FM); common, wooded bottoms, Pike Co., Sept. 29, 1932, *Demaree 9392* (MBG); in sandstone rubble on exposed mountain slope, Arkansas National Forest, Sebastian Co., May 24, 1931, *Palmer 39314* (MBG); 4 mi. southeast of Prescott, July 7, 1912, *Hollister 46* (US); OKLAHOMA: at edge of a pond, Talihina, June 19, 1898, *Glatfelter s.n.* (MBG); Kiamichi River, LeFlore Co., June, 1927, *Ortenburger s.n.* (US).

The striking coextension of the ranges of *T. difforme* and *Taxodium distichum*, as symbolic of the characteristic flora of

the ancient Cretaceous strand, also indicated, is illustrated in text-fig. 2. The most remarkable extension of the species at present recorded is from the banks of Creve Coeur Lake, St. Louis County, Missouri, where a single plant with several mature follicles containing viable seeds was found by the writer during February, 1931. Although in winter condition, the plant was proved correctly identified by the germination

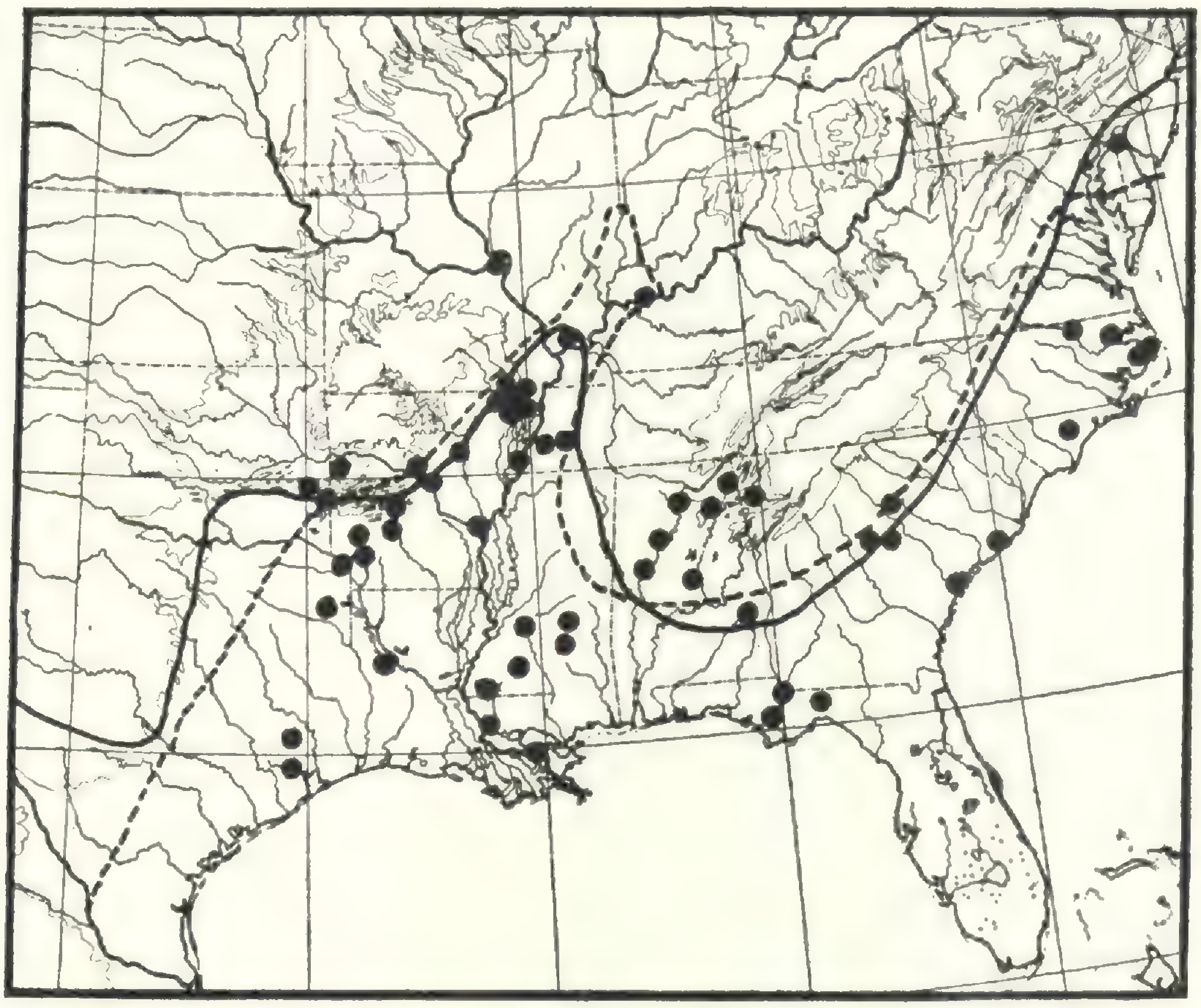

Fig. 2. Solid line: approximate shore-line of the Middle Late Cretaceous period in the southeastern United States (after Schuchert & Dunbar); broken line: approximate northern limit of *Taxodium distichum* (after Berry); dots: known distribution of *Trachelospermum difforme*. Explanation in the text.

and subsequent growth of seedlings from the fruit. Creve Coeur Lake is one of the familiar "ox-bow" lakes of the Missouri River a few miles west of its junction with the Mississippi. Although repeated search has been made, particularly by local botanists of the vicinity of Saint Louis including the original finder, no further evidence of plants has as yet been found. This station is more than 125 miles north of the low-

land of Missouri south of the ancient Cretaceous shore-line of the Mississippi embayment (popularly known by the inhabitants of the district as the "Poplar Bluff" for the occurrence of *Liriodendron tulipifera*) where the species is common, together with *Taxodium distichum* and the associated southeastern Atlantic coastal plain flora. Additional interest in the isolated occurrence of *T. difforme* in the lower Missouri River Valley is found in persistent reports of logs of *Taxodium* washed from time to time by the unruly river from the bordering beds of clay and loess. Although the writer has never been so fortunate as to see actual specimens of such ancient wood, it is generally believed that the former distribution of *T. distichum* in North America was much wider than at present.

Although the flowers and inflorescence of *T. difforme* are rather uniform throughout the distribution of the species, vegetative characters are found to be variable. The leaves are variable in shape and size, and the presence, or relative abundance, of the foliar indument is manifestly inconstant. Particularly striking are occasional plants with very narrowly elliptic to almost linear foliage which are found toward the southwestern limits of the species. In this area, however, are also found plants bearing leaves which are among the broadest of the species. The outline and width of foliage also have been found inconstant upon single specimens. Consequently it has been considered inadvisable to erect varieties for the expression of such fluctuations of vegetative characters.

EXCLUDED SPECIES

Trachelospermum stans A. Gray, Proc. Am. Acad. **21**: 394. 1886 = **Mandevilla foliosa** (Muell.-Arg.) Hemsl. Biol. Centr.-Am. Bot. **2**: 316. 1882 (*Amblyanthera foliosa* Muell.-Arg. Linnaea **30**: 427. 1860).

VIII. Malouetia A. DC.

Malouetia A. DC. in DC. Prodr. **8**: 378. 1844; Muell.-Arg. in Mart. Fl. Bras. **6**^{1}: 89. 1860; Benth. & Hook. Gen. Pl. **2**: 708. 1876; Miers, Apoc. So. Am. 86. 1878; K. Sch. in Engl. & Prantl, Nat. Pflanzenfam. **4**^{2}: 186. 1895.

Robbia A. DC. loc. cit. 444. 1844; Miers, loc. cit. 107. 1878; K. Sch. loc. cit. 187. 1895.

Lactescent shrubs or small trees. Stems ligneous, erect, terete, the branches dichotomous or opposite, rarely alternate. Leaves opposite, entire, penninerved, the upper surface eglandular, the lower surface bearing with more or less frequency a single lenticular or pustulate foveum or pit in the axils of the midrib and primary veins; nodes exstipulate or virtually so. Inflorescence terminal, occasionally lateral as well, umbellate, few- to several-flowered. Calyx 5-parted, the lobes essentially equal, cleft nearly to the receptacle, bearing within alternate, solitary, or rarely geminate, glandular squamellae. Corolla salverform, the tube relatively short in certain species, cylindrical to flask-form, exappendiculate within, the orifice conspicuously callose-thickened[1] in certain species, the limb actinomorphic, 5-parted, dextrorsely convolute. Stamens 5, the anthers almost completely exserted to wholly included in some species, connivent and agglutinated to the stigma, consisting of 2 parallel, basally protuberant sporangia borne ventrally near the apex of an enlarged, sagittate, peltate connective; pollen granular; filaments free. Carpels 2, apocarpous, united at the apex by a common stylar shaft surmounted by the fusiform-subcapitate stigma; ovules numerous, 2–4-seriate, borne upon an axile, binate placenta. Nectaries 5, separate or more or less concrescent. Follicles 2, occasionally solitary by abortion, apocarpous, narrowly terete to broadly fusiform, usually more or less divaricate or falcate, dehiscing along the ventral suture; containing numerous dry, ecomose, glabrous or generally pubescent seeds.

Type species: *Malouetia Tamaquarina* (Aubl.) A. DC. loc. cit. 378. 1844.

The question relative to the congenericity of *Malouetia* and *Robbia* is scarcely nearer solution than in 1860 when the two were combined by Mueller, whose position was later endorsed by Bentham. Miers and Schumann maintained the generic status of *Robbia;* while more recently the broader interpreta-

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[1] Cf. p. (291), *et seq.*

tion of the plexus has been reaffirmed by Markgraf (in Pulle, Fl. Surinam **4**: 56. 1932).

The distinction of the two genera evidently rests solely upon the character of the seeds, whether glabrous, as in typical *Malouetia*, or pubescent, as in the species referred to *Robbia* by de Candolle. No other distinguishing characters have been advanced by any competent student of the genus. Although such a character as that of the seeds is doubtless of genuine biological significance, it can scarcely be interpreted as more so than, for example, the absence of latex in *Asclepias tuberosa*, which would properly be frowned upon as the basis of a generic segregation largely on the basis of practice. Similarly in the instance of *Robbia* and *Malouetia*, fruit is so rare in herbarium collections that separation of the genera upon that single character would prove extremely difficult in the absence of additional criteria. For a number of species, fruit is unknown at the present writing.

Intergradation of the seminal indument of *Robbia* further weakens the claim of that character as of generic, or even subgeneric or sectional value. The seeds of *Malouetia Tamaquarina* (Aubl.) A. DC. are absolutely glabrous: those of *M. furfuracea* Muell.-Arg. are very sparsely villous. Yet these two species are scarcely separable in flowering material, and are indigenous to an almost identical area. The seeds of *M. cestroides* (Nees) Muell.-Arg., not distantly related to the preceding, are densely lanate-villous.

In view of our imperfect understanding of the group, the most practical policy would appear to be the inclusion of *Robbia* within *Malouetia*.

KEY TO THE SECTIONS

A. Anthers conspicuously exserted (except in *M. Mexiae* and *M. cestroides*), inserted near the orifice of the corolla-tube.........Sect. 1. Tamaquarinae

AA. Anthers included, or essentially so, inserted about midway, or deeper, within the corolla-tube...............................Sect. 2. Graciles

Sect. 1. Tamaquarinae Woodson. Corolla-tube cylindrical to broadly flask-form, gradually narrowing toward the insertion of the stamens; anthers ovate to elliptic, conspicuously ex-

serted (essentially included, or barely exserted in *M. Mexiae* and *M. cestroides*), inserted near the orifice of the corolla-tube. *Spp. 1–15.*

KEY TO THE SPECIES

a. Calyx-lobes delicate and foliaceous in texture, not closely imbricated at anthesis, spreading; corolla-tube flask-form, conspicuously inflated below the middle.
  b. Anthers conspicuously exserted; corolline faucal tube 0.05–0.075 cm. long.
    c. Corolla without a callose faucal annulus;* plants of the lower Amazon Valley (Para) .... *1. M. flavescens*
    cc. Corolla with a definite faucal annulus.
      d. Corolla-tube 0.8–1.3 cm. long; calyx-lobes lanceolate to linear-lanceolate, 0.25–0.5 cm. long.
        e. Corolla-tube 0.8–1.0 cm. long, the lobes 0.9–1.2 cm. long; faucal annulus relatively indefinite, consisting of numerous minute, callose protuberances; plants of the Antilles (St. Vincent, Cuba?) .... *2. M. cubana*
        ee. Corolla-tube 1.1–1.3 cm. long, the lobes 1.2–1.6 cm. long; faucal annulus conspicuous, 5-lobed; plants of British Guiana .... *3. M. Schomburgki*
      dd. Corolla-tube 0.6–0.7 cm. long; calyx-lobes ovate to ovate-lanceolate, 0.15–0.25 cm. long; plants of the lower Amazon Valley (Para) .... *4. M. lata*
  bb. Anther-tips barely surpassing or attaining the corolline orifice; faucal tube 0.2–0.25 cm. long; plants of the Amazon Valley (Para and Amazonas) .... *5. M. Mexiae*
aa. Calyx-lobes relatively fleshy and coriaceous in texture, closely imbricated at anthesis; corolla-tube cylindrical, or only somewhat flask-form in certain species.
  b. Corolla relatively delicate in texture, the tube 0.4–0.9 cm. long.
    c. Leaves wholly glabrous.
      d. Anthers barely included, or the tips barely exserted...... *6. M. cestroides*
      dd. Anthers conspicuously exserted.
        e. Leaves membranaceous, conspicuously foveate in the axils of the midrib; plants of southeastern Brazil (Rio de Janeiro, Minas Geraes, São Paulo) .... *7. M. arborea*
        ee. Leaves subcoriaceous, inconspicuously and rarely foveate in the axils of the midrib; plants of northern Brazil (Para, Amazonas) and adjacent Colombia .... *8. M. Duckei*
    cc. Leaves softly puberulent beneath .... *9. M. pubescens*
  bb. Corolla relatively fleshy in texture, the tube 0.9–1.5 cm. long.
    c. Leaves wholly glabrous.
      d. Leaves definitely petiolate.
        e. Corolla-lobes puberulent within, at least toward the base.

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* Cf. p. (291), *et seq.*

f. Calyx-lobes 0.2–0.3 cm. long, ⅕–¼ (rarely ⅓) as long as the corolla-tube, obtuse, occasionally broadly acute; seeds glabrous .... *10. M. Tamaquarina*

ff. Calyx-lobes 0.3–0.5 cm. long, ⅓–½ as long as the corolla-tube, acute to acuminate; seeds sparsely villous...... *11. M. furfuracea*

ee. Corolla-lobes about uniformly papillate to glabrate within and without.

f. Leaves oblong-oblanceolate, obtuse or rounded; corolla-tube 0.9 cm. long................................. *12. M. glandulifera*

ff. Leaves ovate to lance-elliptic, acutely acuminate; corolla-tube 1.2–1.5 cm. long............................ *13. M. peruviana*

dd. Leaves sessile or subsessile, and more or less amplexicaul.......... .... *14. M. amplexicaulis*

cc. Leaves softly and minutely puberulent beneath............ *15. M. Killipii*

1. **Malouetia flavescens** Muell.-Arg. in Mart. Fl. Bras. 6[1]: 95. 1860.

Small shrubs (fide Ducke); stems relatively slender, glabrous, reddish-brown, very inconspicuously lenticellate when fully mature; leaves opposite, shortly petiolate, oblong-elliptic, subcaudate-acuminate, base obtuse, 7–11 cm. long, 2.5–4.5 cm. broad, membranaceous, glabrous throughout, light olivaceous in desiccation, somewhat subnitidulous above, opaque beneath, infrequently and obscurely foveate in the axils of the midrib; petioles 0.1–0.3 cm. long, glabrous; umbels terminal, few-flowered; peduncle 0.1–0.3 cm. long, glabrous; pedicels 1.8–2.0 cm. long, somewhat accrescent in fruit, glabrous; calyx-lobes lanceolate, acuminate, spreading at anthesis, not closely imbricated, 0.3–0.35 cm. long, rather delicately foliaceous, puberulent-papillate within, minutely papillate without; corolla broadly flask-form, greenish, the tube 1.0–1.1 cm. long, about 0.15 cm. in diameter at the base, dilated to about 0.3 cm. in diameter below the middle, faucal tube 0.075 cm. long, about 0.175 cm. in diameter at the orifice, indefinitely papillate to essentially glabrate without, minutely puberulent generally within, the lobes obliquely oblong-lanceolate, long-acuminate, 1.1–1.2 cm. long, about 0.25 cm. broad, sharply reflexed, the tips usually more or less turbinate, minutely papillate without, minutely puberulent toward the base within; anthers conspicuously exserted, ovate-elliptic, 0.3–0.325 cm. long, minutely puberulent dorsally; ovary about 0.1 cm. long, minutely puberu-

lent; stigma 0.15 cm. long; nectaries less than half equalling the ovary; follicles terete, 18–20 cm. long, about 0.4 cm. in diameter, falcate, glabrous; seeds 3–4 cm. long, 0.2–0.3 cm. in diameter, glabrous.

BRAZIL: PARA: ad cataractam infimam loco Maria Luiza, silva, Rio Tapajoz, Sept. 27, 1922, *Ducke 11394* (B, S, US).

The type specimen of this species (*Hoffmannsegg s.n.* in herb. Willdenow, fide Muell.-Arg.) has not been available for examination. However, the specimen cited agrees so well with the satisfyingly complete original description that its relegation to *M. flavescens* appears to be well substantiated.

2. Malouetia cubana A. DC. in DC. Prodr. **8**: 379. 1844; Miers, Apoc. So. Am. 92. 1878.

Malouetia retroflexa Muell.-Arg. Linnaea **30**: 408. 1860.

Stems relatively slender, glabrous, reddish-brown, inconspicuously lenticellate when fully mature; leaves opposite, shortly petiolate, oblong-elliptic, apex shortly and obtusely subcaudate-acuminate, base obtuse to broadly acute, 5–11 cm. long, 1.5–4.5 cm. broad, membranaceous, glabrous throughout, olivaceous in desiccation, somewhat subnitidulous above, opaque beneath, minutely foveate in the axils of the midrib; petioles 0.15–0.5 cm. long; umbels terminal, few-flowered; peduncle 0.2–0.4 cm. long; pedicels 2.0–2.3 cm. long, glabrous; calyx-lobes lanceolate to ovate-lanceolate, acuminate, spreading at anthesis, not closely imbricated, 0.3–0.45 cm. long, rather delicately foliaceous, glabrous without, minutely and sparsely puberulent-papillate toward the tips within; corolla broadly flask-form, greenish-white (?), the tube 0.8–1.0 cm. long, about 0.1–0.15 cm. in diameter at the base, dilated to about 0.2–0.25 cm. below the middle, faucal tube 0.05 cm. long, orifice about 0.15 cm. in diameter, faucal annulus relatively indefinite, consisting of numerous minute, callose protuberances, glabrous without, very minutely puberulent within, the lobes obliquely lanceolate to ovate-lanceolate, acuminate, 0.9–1.2 cm. long, about 0.2 cm. broad, sharply reflexed, the tips usually more or less turbinate, minutely papillate without, minutely puberulent toward the base within; anthers conspicuously exserted,

ovate-elliptic, 0.3–0.325 cm. long, minutely puberulent dorsally; ovary about 0.125 cm. long, minutely puberulent; stigma 0.125–0.15 cm. long; nectaries about 1/3 equalling the ovary; follicles unknown.

ST. VINCENT: exact locality lacking, 1822, *Guilding s.n.* (K, MBG, photograph and analytical drawings).

I am strongly inclined to the opinion expressed by Miers (loc. cit. 1878) that the original descriptions of *M. cubana* and *M. retroflexa* can scarcely be interpreted as applying to distinct species. The type specimen of the former, *de la Ossa s.n.*, should presumably be deposited in the herbarium of de Candolle, but it was not found during my examination of the collection in 1930. At any rate, the species has evidently not been collected in Cuba since the discovery of the type. Ambiguity likewise surrounds the present status of *M. retroflexa* in St. Vincent. Beside the type collection, made over a hundred years ago, a specimen with only the data "*Echites guianensis;* West-Indien," has been found in the herbarium at Vienna, and another, presumably a duplicate of the type, at Berlin with the notation "St. Vincent; Lindley misit 1827."

3. **Malouetia Schomburgki** Muell.-Arg. Linnaea **30**: 409. 1860; Miers, Apoc. So. Am. 88. 1878.

Shrubs or small trees, 1.8–3.0 m. tall (fide de la Cruz); stems relatively slender, glabrous, reddish-brown, inconspicuously lenticellate when fully mature; leaves opposite, petiolate, oblong- to ovate-elliptic, apex obtusely subcaudate-acuminate, base obtuse to broadly acute, 4.5–13.0 cm. long, 2.0–5.5 cm. broad, firmly membranaceous to somewhat subcoriaceous, glabrous throughout, light olivaceous in desiccation, nitidulous above, opaque, minutely foveate in the axils of the midrib beneath; petioles 0.2–0.5 cm. long, glabrous; umbels terminal, bearing several white (or brownish ?) flowers; peduncle 0.2–0.5 cm. long; pedicels 0.15–0.3 cm. long, glabrous; calyx-lobes lanceolate to linear-lanceolate, acuminate, 0.25–0.5 cm. long, glabrous to very minutely papillate without, minutely puberulent-papillate toward the tips within, rather delicately foliaceous, spreading at anthesis, not closely imbricated; corolla

broadly flask-form, the tube 1.1–1.3 cm. long, about 0.1–0.125 cm. in diameter at the base, dilated to about 0.25–0.3 cm. below the middle, faucal tube 0.05–0.075 cm. long, about 0.1–0.15 cm. in diameter at the orifice, faucal annulus conspicuous, 5-lobed, glabrous without, minutely puberulent within, the lobes obliquely oblong-lanceolate, acuminate, 1.2–1.6 cm. long, 0.175–0.25 cm. broad, sharply reflexed, the tips usually more or less turbinate, minutely papillate or puberulent-papillate without, puberulent toward the base within; anthers conspicuously exserted, ovate-elliptic, 0.25–0.3 cm. long, minutely puberulent dorsally; ovary about 0.1 cm. long, minutely puberulent; stigma 0.1–0.125 cm. long; nectaries ⅓–½ equalling the ovary; follicles terete, 16–36 cm. long, 0.3–0.4 cm. in diameter, falcate, glabrous; seeds 2.5–4.0 cm. long, glabrous.

British Guiana: Ufer der fl. Pomeroon, Aug., 1843, *Schomburgk 1386* (B, syntype, MBG, photograph); Waini River, Northwest District, Sept. 13, 1921, *Cruz 1116* (G, NY, US); Cart Market, Moruka River, Pomeroon District, Sept. 20, 1921, *Cruz 1157* (NY, US); Anabisi River, Northwest District, Febr. 15, 1922, *Cruz 1360* (FM, NY, US); upper Rupununi River, near Dadanawa, June 3, 1922, *Cruz 1476* (MBG, NY, US); vicinity of Bartica, Essequibo River, Sept. 3–12, 1922, *Cruz 1874* (FM, G, MBG, NY, US); Kabakaburi, Pomeroon District, Febr. 10–15, 1923, *Cruz 3242* (FM, MBG, NY, US); Wanama River, Northwest District, May 10–23, 1923, *Cruz 3935* (MBG, NY, US); Kamakusa, upper Mazaruni River, July 11–12, 1923, *Cruz 4232* (MBG, NY, US); data incomplete, *Schomburgk 830* (V, paratype).

4. Malouetia lata Mgf. Notizblatt **10:** 1037. 1930.

Shrubs (fide Ducke); stems relatively stout, glabrous, reddish-brown, inconspicuously lenticellate when fully mature; leaves opposite, shortly petiolate, broadly oblong- to ovate-elliptic, apex obtusely subcaudate-acuminate, base obtuse to rounded, 5–12 cm. long, 3–7 cm. broad, rather delicately membranaceous, glabrous throughout, olivaceous in desiccation, slightly nitidulous above, opaque, very inconspicuously foveate in the axils of the midrib beneath; petioles 0.2–0.5 cm. long, glabrous; umbels terminal, bearing relatively few, greenish-white flowers; peduncle 0.1–0.3 cm. long; pedicels 0.7–0.8 cm. long, glabrous; calyx-lobes ovate to ovate-lanceolate, acuminate, 0.15–0.25 cm. long, spreading at anthesis, not closely imbricated, rather delicately foliaceous in texture, glabrous with-

out, minutely and rather sparsely puberulent-papillate at the tips within; corolla broadly flask-form, the tube 0.6–0.7 cm. long, about 0.1 cm. in diameter at the base, dilated to 0.25–0.3 cm. below the middle, faucal tube 0.05 cm. long, about 0.125 cm. in diameter at the orifice, faucal annulus conspicuous, 5-lobed, without minutely papillate below, otherwise glabrous, within minutely puberulent to puberulent-papillate, the lobes obliquely oblong-elliptic, acuminate, 0.7–0.8 cm. long, sharply reflexed, minutely papillate without, minutely puberulent toward the base within; anthers conspicuously exserted, ovate-elliptic 0.25 cm. long, minutely puberulent dorsally; ovary about 0.1 cm. long, minutely puberulent; stigma 0.1 cm. long; nectaries about ½ equalling the ovary; follicles terete, 40–45 cm. long, 0.4–0.5 cm. in diameter, falcate, glabrous; seeds 0.35–0.4 cm. long, about 0.2 cm. in diameter, glabrous.

BRAZIL: PARA: Parana de Juruty Velho, silva ab Amazonium fluvio periodice inundata, Febr. 26, 1926, *Ducke 21591* (B, TYPE, S, US, MBG, photograph and analytical drawings); Cacaval Imperial prope Obidos, silva ab Amazonium fluvio periodice inundata, Sept. 12, 1910, *Ducke 21784* (B); AMAZONAS: Rio Antimary (Purus), silva paludosa, April 1, 1904, *Huber 21764* (B).

5. **Malouetia Mexiae** Woodson, spec. nov.

Arbusculae vel frutices; ramulis glaberrimis cortice atrobrunneis maturitate inconspicue lenticellatis; foliis oppositis breviter petiolatis oblongo-ellipticis apice obtuse subcaudato-acuminatis basi obtusis 6–12 cm. longis 0.15–0.4 cm. latis coriaceis glaberrimis supra subnitidulis subtus opacis in axillis nervi medii inconspicue foveatis; petiolis 0.2–0.4 cm. longis glabris; umbellis terminalibus flores 4–10 pallide viridulas gerentibus; pedunculo 0.2–0.5 cm. longo; pedicellis 1.5–2.5 cm. longis glaberrimis; calycis laciniis ovatis vel ovato-lanceolatis acuminatis 0.25–0.35 cm. longis tenuiter foliaceis ex apice patulis haud imbricatis extus minute papillatis intus minute puberulis; corollae ampulliformis tubo 0.9–1.2 cm. longo basi ca. 0.1–0.15 cm. diametro metiente deinde sub medio usque 0.275–0.35 cm. dilatato faucibus tubularibus 0.2–0.25 cm. longis ostio ca. 0.15 cm. diametro metiente conspicue calloso-annulato extus glabro intus prope insertionem staminum puberulo-papillato lobis anguste et oblique elliptico-oblanceolatis acuminatis 0.9–

1.4 cm. longis 0.25–0.3 cm. latis patentibus extus papillatis intus prope basem puberulis; antheris inclusis vel paululo exsertis ovato-ellipticis 0.25–0.3 cm. longis dorso minute puberulis puberulo-papillatisve; ovario ca. 0.1 cm. longo minutissime puberulo; stigmate 0.1 cm. longo; nectariis ovario ca. dimidio brevioribus; folliculis ignotis.

Shrubs or small trees; stems glabrous, reddish-brown, inconspicuously lenticellate when fully mature; leaves opposite, shortly petiolate, oblong-elliptic, apex obtusely subcaudate-acuminate, base obtuse, 6–12 cm. long, 0.15–0.4 cm. broad, coriaceous, glabrous throughout, above subnitidulous, beneath opaque, inconspicuously foveate in the axils of the midrib; petioles 0.2–0.4 cm. long; umbels terminal, bearing 4–10 pale greenish flowers; peduncle 0.2–0.5 cm. long; pedicels 1.5–2.5 cm. long, glabrous; calyx-lobes ovate to ovate-lanceolate, acuminate, 0.25–0.3 cm. long, delicately foliaceous, spreading at anthesis, not closely imbricated, minutely papillate without, within minutely puberulent; corolla-tube flask-form, 0.9–1.2 cm. long, about 0.1–0.15 cm. in diameter at the base, dilated to 0.275–0.35 cm., faucal tube 0.2–0.25 cm. long, about 0.15 cm. in diameter at the orifice, faucal annulus conspicuous, 5-lobed, the lobes narrowly and obliquely elliptic-oblanceolate, acuminate, 0.9–1.4 cm. long, 0.25–0.3 cm. broad, sharply reflexed, without minutely papillate, puberulent toward the base within; anthers ovate-elliptic, 0.25–0.3 cm. long, included, or the tips barely exserted, minutely puberulent to puberulent-papillate dorsally; ovary about 0.1 cm. long, very minutely puberulent; stigma 0.1 cm. long; nectaries about ½ equalling the ovary; follicles unknown.

BRAZIL: PARA: Thomé Assu, Districto Acara, Rio Acara, overflow bank in dense shade, July 28, 1931, *Mexia 5994* (MBG, TYPE); inter Mosquiero et Carananduba, in ripis inundatis fluvii Para, May 13, 1923, *Ducke 17465* (B); ad ripas inundatas fluminis Jaburuzinho, regione Breves, aestuarii amazonici, July 12, 1923, *Ducke 17466* (B); Cameta, silvula secundaria, Sept. 13, 1903, *Siquiera 21771* (B); AMAZONAS: Rio Negro infer., loco Terra Preta, silva paludosa, Dec. 31, 1923, *Kuhlmann 21868* (B).

Sharply differentiated from its relatives of the *Schomburgki* plexus by the included or barely exserted anthers, a position caused by the extension of the faucal tube of the corolla. The

texture of the leaves, in addition, is more heavy than that of its related congeners. *Siquiera 21771* and *Kuhlmann 21868* are placed within this species somewhat doubtfully because of a lack of fully expanded floral buds.

6. **Malouetia cestroides** (Nees) Muell.-Arg. in Mart. Fl. Bras. **6**[1]: 94. *pl. 29. fig. 2.* 1860.

Tabernaemontana cestroides Nees, ex Mart. Nov. Act. Nat. Cur. **11**: 83. 1823.

Robbia cestroides (Nees) A. DC. in DC. Prodr. **8**: 445. 1844; Deles. Icon. **5**: *pl. 52.* 1846; Miers, Apoc. So. Am. 107. 1878; K. Sch. in Engl. & Prantl, Nat. Pflanzenfam. **4**[2]: 187. 1895.

Shrubs or small trees; stems relatively stout, glabrous, reddish-brown, inconspicuously lenticellate when fully mature; leaves opposite, shortly petiolate, oblong- to ovate-elliptic, apex obtusely acuminate, base obtuse to broadly acute, 6–12 cm. long, 2.0–4.5 cm. broad, firmly membranaceous, glabrous throughout, above somewhat nitidulous, beneath opaque, minutely foveate in the axils of the midrib; petioles 0.2–0.6 cm. long; umbels terminal, relatively few-flowered; peduncle 0.2–0.4 cm. long; pedicels 0.8–1.0 cm. long, glabrous; calyx-lobes ovate, obtuse to rounded, occasionally broadly acute, 0.1–0.125 cm. long, relatively thick in texture, closely imbricated at anthesis, glabrous without, papillate toward the tips within; corolla salverform, only slightly inflated toward the base, the tube 0.75–0.8 cm. long, about 0.075–0.1 cm. in diameter at the base, faucal tube 0.125–0.15 cm. long, about 0.1 cm. in diameter at the orifice, faucal annulus conspicuous, 5-lobed, glabrous without, minutely puberulent above within, the lobes obliquely elliptic-lanceolate, acuminate, 0.6–0.8 cm. long, reflexed, papillate without, minutely puberulent toward the base within; anthers barely included or the tips barely exserted, ovate-elliptic, 0.2 cm. long, very minutely pilosulose dorsally; ovary about 0.15 cm. long, minutely puberulent; stigma 0.1 cm. long; nectaries about ½ equalling the ovary; follicles terete, 11–12 cm. long, about 0.5 cm. in diameter, somewhat divaricate, glabrous; seeds 2.5–3.0 cm. long, densely lanate-villous.

BRAZIL: BAHIA: Vittoria, date lacking, *Sello s.n.* (B); Nazareth, date lacking, *Sello s.n.* (B); data incomplete, *Blanchet 1738* (MBG); *Blanchet 1578* (MP); RIO DE JANEIRO: Gavea, Jan. 3, 1872, *Glaziou 5934* (B, NY); MINAS GERAES: data incomplete, Aug.–April, 1840, *Claussen s.n.* (Camb.); DATA INCOMPLETE: *Martius 105* (Bx, TYPE, V, MBG, photograph); *Riedel s.n.* (B, V); *Regel s.n.* (Camb.).

7. **Malouetia arborea** (Vell.) Miers, Apoc. So. Am. 89. 1878.

Echites arborea Vell. Fl. Flum. 114. 1830; Icon. **3**: *pl. 47.* 1827.

Tabernaemontana laeta Mart. according to A. DC. in DC. Prodr. **8**: 364. 1844, as to synonymy, in part.

Malouetia Tamaquarina A. DC. γ. *Brasiliensis* A. DC. loc. cit. 379. 1844.

Malouetia lanceolata Muell.-Arg. in Mart. Fl. Bras. **6**^{1}: 93. *pl. 29. fig. 3.* 1860; Miers, loc. cit. 88. 1878; K. Sch. in Engl. & Prantl, Nat. Pflanzenfam. **4**^{2}: 187. 1895.

Malouetia Martii Muell.-Arg. loc. cit. 94. *pl. 29.* 1860; Miers, loc. cit. 90. 1878.

Secondatia ? arborea (Vell.) Muell.-Arg. loc. cit. 110. 1860.

Robbia gossipina Miers, loc. cit. 108. *pl. 12. fig. B.* 1878.

Small trees (12 m. tall, fide Kuhlmann); stems relatively stout, glabrous, reddish-brown, rather inconspicuously lenticellate when fully mature; leaves opposite, petiolate, oblong-elliptic, apex obtusely subcaudate-acuminate, base obtuse to broadly acute, 4–12 cm. long, 1.3–4.0 cm. broad, membranaceous, glabrous throughout, above somewhat subnitidulous, beneath opaque, conspicuously foveate in the axils of the midrib; petioles 0.3–0.5 cm. long; umbels terminal, bearing several small, white flowers; peduncle 0.2–0.4 cm. long; pedicels 0.9–1.0 cm. long, glabrous; calyx-lobes ovate, acute to obtuse, 0.15–0.2 cm. long, relatively thick in texture, closely imbricated at anthesis, without glabrous to minutely papillate, within papillate at the tips; corolla salverform, only slightly inflated at the base, the tube 0.7–0.8 cm. long, about 0.1 cm. in diameter at the base, faucal tube 0.05–0.1 cm. long, about 0.1–0.125 cm. in diameter at the orifice, faucal annulus conspicuous, 5-lobed, without glabrous or rarely very minutely papillate, within very sparsely and minutely puberulent above, the lobes obliquely

elliptic-lanceolate, acuminate, 0.8–0.95 cm. long, 0.25–0.3 cm. broad, reflexed, without minutely papillate, within minutely puberulent toward the base; anthers conspicuously exserted, ovate-elliptic, 0.2 cm. long, minutely puberulent dorsally; ovary 0.1 cm. long, minutely puberulent; stigma 0.08–0.1 cm. long; nectaries about ½ equalling the ovary; follicles terete, 9–14 cm. long, 0.7–0.8 cm. in diameter, divaricate, glabrous; seeds 3.5–4.0 cm. long, densely lanate-villous.

BRAZIL: RIO DE JANEIRO: S. Luiz, Aug. 9, 1867, *Glaziou 1989* (MP); Gavea, Jan. 3, 1872, *Glaziou 5934* (MP); Fazenda de Sta. Cruz, Aug. 8, 1877, *Glaziou 9511* (B, MP); Carcadura, Dec. 23, 1869, *Glaziou 4077* (B, MP); ad urbem in silvis Chacara do Fonseca, Jan. 3, 1922, *Occhioni 4459* (B, MP); Itatiaia, Dec., 1918, *Porto 8671* (B); ad urbem in loco Sta. Theresa, silva secundaria, Dec. 15, 1925, *Kuhlmann 21877* (B); data incomplete, *Weddell s.n.* (MP); *Schott s.n.* (V); *Mikan s.n.* (V); *Gardner 5547* (B, Camb., MP, V); MINAS GERAES: Ilheos, date lacking, *Martius 966* (B, M, MBG, NY, V); Organ Mts., Jan., 1838, *Miers 4027* (US); SÃO PAULO: in campis editoribus prope S. Paulo civitatem, Dec.–Jan., year lacking, *Martius 324* (M); DATA INCOMPLETE: *Riedel s.n.* (B, MP, NY); *McRae s.n.* (Camb.).

That Miers was correct in interpreting *Echites arborea* Vell. as a member of the genus *Malouetia* must be agreed after an examination of the plate and text by any one familiar with the characters of the group. Vellozo's plate *(pl. 47)* not only indicates the foliar foveae, so pronounced in *M. lanceolata* and *M. Martii*, the type specimens of which appear clearly conspecific, but those extremely characteristic structures of the leaves are specifically described as "poris in divisione nervorum ad costam," which could possibly apply only to species of *Malouetia* (or the liana *Forsteronia)* in the American flora. The general habit, relative size of the flowers, exserted anthers, and distribution (Mendanha, D. F.) completely clarify the natural affinities of this species. Miers also called attention to the erroneous inclusion of a comose seed in Vellozo's plate, possibly explaining Mueller's relegation of the species to *Secondatia*.

8. **Malouetia Duckei** Mgf. Notizblatt **9**: 962. 1926.

Trees (20 m. tall, fide Ducke); stems relatively stout, glabrous, reddish-brown, inconspicuously lenticellate when fully mature; leaves opposite, petiolate, oblong-elliptic, apex shortly

and obtusely acuminate, base obtuse to broadly acute, 6–13 cm. long, 1.5–5.5 cm. broad, subcoriaceous, glabrous throughout, nitidulous above, beneath opaque, rarely and very inconspicuously foveate in the axils of the midrib; petioles 0.3–0.6 cm. long, glabrous; umbels terminal, bearing relatively numerous greenish-white flowers; peduncle 0.2–0.4 cm. long; pedicels 0.3–0.5 cm. long, minutely papillate to puberulent-papillate; calyx-lobes ovate, acute, 0.15–0.2 cm. long, closely imbricated at anthesis, papillate within and without; corolla salverform, only slightly broadening toward the base, 0.75–0.9 cm. long, about 0.1 cm. in diameter at the base, faucal tube 0.1 cm. long, about 0.15 cm. in diameter at the orifice, faucal annulus relatively conspicuous, very minutely puberulent or puberulent-papillate without, papillate within, the lobes obliquely oblong-elliptic, acute to acuminate, 0.7–0.8 cm. long, 0.25–0.3 cm. broad, reflexed, papillate to puberulent-papillate within, particularly toward the base, minutely papillate without; anthers conspicuously exserted, ovate-elliptic, 0.25 cm. long, very minutely and sparsely pilosulose to puberulent-papillate dorsally; ovary 0.1 cm. long, puberulent-papillate; stigma 0.125–0.15 cm. long; nectaries ½–⅔ equalling the ovary; follicles unknown.

COLOMBIA: CAQUETA: Rio Caqueta, super cataractas Cupaty, silva non inundabilis, Nov. 18, 1912, *Ducke 21822* (B, US).

BRAZIL: PARA: Itaituba, Rio Tapajoz, silva non inundata, Aug. 26, 1923, *Ducke 17464* (B, TYPE, S, US, MBG, photograph and analytical drawings); Faro, silva non inundabilis, Aug. 26, 1907, *Ducke 21625* (B, US); AMAZONAS: Manãos, silva non inundabili ultra locum Flores, Aug. 10, 1932, *Ducke 23952* (B).

The specimen from Amazonian Colombia is placed with this species rather reluctantly because of the smaller foliage leaves, which are much more conspicuously foveate beneath than among the typical specimens from lower downstream. It is hoped that the discovery of fruit may enable a sharper distinction between this species and the preceding which it closely resembles.

9. **Malouetia pubescens** Mgf. Notizblatt **9**: 88. 1924.

Shrubs or small trees (3–8 m. tall, fide Ule); stems relatively stout, very minutely puberulent when young, soon becoming glabrate, dark reddish-brown, rather inconspicuously lenticel-

late when fully mature; leaves opposite, shortly petiolate, oblong-elliptic, apex obtusely acuminate, base obtuse, 5–10 cm. long, 1.5–4.0 cm. broad, firmly membranaceous, above somewhat nitidulous, beneath finely and densely puberulent; petioles 0.3–0.4 cm. long, minutely puberulent; umbels terminal, bearing relatively few small, white flowers; peduncle 0.2–0.3 cm. long; pedicels 0.4–0.5 cm. long, minutely puberulent; calyx-lobes ovate, acute, 0.15–0.17 cm. long, minutely puberulent; corolla salverform, only somewhat swollen toward the base, the tube 0.4–0.45 cm. long, about 0.125 cm. in diameter at the base, faucal tube 0.075 cm. long, about 0.1 cm. in diameter at the orifice, glabrous without, or essentially so, within minutely puberulent-papillate above, the lobes obliquely ovate-oblong, obtuse or broadly acute, 0.55–0.6 cm. long, reflexed, papillate without, minutely puberulent within, particularly toward the base; anthers conspicuously exserted, ovate-elliptic, 0.175 cm. long, minutely pilosulose dorsally; ovary 0.1 cm. long, minutely puberulent; stigma 0.05 cm. long; nectaries about equalling the ovary; follicles unknown.

Brazil: amazonas: in Campwald bei S. Marcos, Rio Branco, Dec., 1908, *Ule 7827* (B, type, US, MBG, photograph and analytical drawings).

A peculiar and characteristic species whose association with the *cestroides-arborea* complex must be confirmed by fruiting specimens.

10. **Malouetia Tamaquarina** (Aubl.) A. DC. in DC. Prodr. **8**: 378. 1844; Muell.-Arg. in Mart. Fl. Bras. **6**[1]: 92. *pl. 26. fig. 2.* 1860; Miers, Apoc. So. Am. 87. 1878; K. Sch. in Engl. & Prantl, Nat. Pflanzenfam. **4**[2]: 187. 1895.

Cameraria Tamaquarina Aubl. Hist. Pl. Gui. Fr. **1**: 260; **3**: *pl. 102.* 1775.

Cameraria Guyanensis Aubl. loc. cit. 262. 1775.

Cameraria lutea Lam. Encycl. **1**: 573. 1783.

Tabernaemontana odorata Vahl, Eclog. **2**: 22. 1798.

Malouetia Tamaquarina A. DC. β. *minor* A. DC. loc. cit. 379. 1844.

Malouetia odorata (Vahl) A. DC. loc. cit. 1844; Miers,

Apoc. So. Am. 87. 1878 (where erroneously attributed to himself).

Malouetia obtusiloba A. DC. loc. cit. 1844; Miers, loc. cit. 88. 1878 (where erroneously cited as *obtusifolia*).

Malouetia albiflora Miq. Stirp. Surinam. Sel. 161. 1851.

Malouetia Tamaquarina A. DC. β. *brasiliensis* Muell.-Arg. loc. cit. 1860, not A. DC., in part as to specimens cited.

Malouetia Tamaquarina A. DC. γ. *lancifolia* Muell.-Arg. loc. cit. 1860.

Malouetia Guianensis (Aubl.) Miers, loc. cit. 87. 1878.

Malouetia Tarumensis Benth. ex Miers, loc. cit. 1878, sphalm.

Shrubs and small trees (3–10 m. tall, fide de la Cruz and Monteiro da Costa); stems relatively stout, glabrous, inconspicuously lenticellate when fully mature; leaves opposite, shortly petiolate, narrowly oblong- to ovate-elliptic, apex subcaudate-acuminate, base obtuse, 4–15 cm. long, 1.3–7.0 cm. broad, membranaceous, glabrous throughout, opaque, inconspicuously foveate in the axils of the midrib beneath; petioles 0.2–0.4 cm. long, glabrous; umbels terminal, bearing relatively few yellowish- or greenish-white flowers (or purplish according to certain collectors); peduncle 0.2–0.4 cm. long; pedicels 1–2 cm. long, glabrous; calyx-lobes ovate, obtuse to broadly acute, 0.2–0.3 cm. long, coriaceous, closely imbricated at anthesis, glabrous to minutely papillate without, minutely papillate within; corolla salverform, occasionally somewhat inflated at the base, relatively fleshy in texture, the tube 0.9–1.5 cm. long, about 0.1–0.15 cm. in diameter at the base, occasionally dilating to as much as 0.3 cm. below the middle, faucal tube 0.1–0.15 cm. long, about 0.15–0.25 cm. in diameter at the orifice, faucal annulus conspicuous, 5-lobed, glabrous without, minutely puberulent toward the insertion of the stamens within, the lobes obliquely oblong- to obovate-elliptic, obtusish to shortly acuminate, 0.9–1.7 cm. long, reflexed, papillate to minutely puberulent-papillate without, minutely puberulent or pilosulose, particularly toward the base within; anthers conspicuously exserted, ovate-elliptic, 0.25–0.4 cm. long, minutely puberulent dorsally; ovary 0.15–0.2 cm. long, minutely puberulent to puberulent-

papillate; stigma 0.1–0.15 cm. long; nectaries ½–⅔ equalling the ovary; follicles terete, 10–35 cm. long, 0.4–0.5 cm. in diameter, falcate, glabrous; seeds 3.5–4.5 cm. long, 0.35–0.4 cm. in diameter, glabrous.

BRITISH GUIANA: Pomeroon River, Pomeroon District, Dec. 17–24, 1922, *Cruz 3135* (FM, G, US); Kamakusa, upper Mazaruni River, July 11–22, 1923, *Cruz 4083* (FM); between the Demerara and Berbice Rivers, July 15–19, 1922, *Cruz 1660* (MBG); Amakura River, Northwest District, March 23–30, 1923, *Cruz 3473* (FM, US); Aruka R., Barima R., Northwest District, June, 1908, *Anderson 60* (FM); on bank, Moraballi Creek, near Bartica, alt. near sea-level, Sept. 18, 1929, *Sandwith 283* (NY); rip. fl. Pomeroon, Aug., 1843, *Schomburgk 1378* (B); data incomplete, *Schomburgk 39* (V); *Schomburgk 788* (Camb., MP); *Schomburgk 800* (V); *Schomburgk 951* (B, V).

DUTCH GUIANA: fluv. Coppename sup., Aug., 1901, *Boon 1044* (B, U); Kaboerie, fl. Corantyne, June 21, 1916, *Gonggrijp 2135* (B, US); ad fl. Marowyne med., Aug., 1847, *Kappler 1825* (MP, S, V); ad fl. Marowyne super. in rupestribus, Sept., year lacking, *Kappler 2087* (B); data incomplete, *Kappler 444a* (B, M, MP, S, V); *Kappler 1955* (MP, S); *Hostmann 269* (Camb., D, FM, M, NY, S, V).

FRENCH GUIANA: Karouany, 1855, *Sagot 392* (B, MP, V); *Sagot 1143* (B, MP, V); environs de Godebert, date lacking, *Wackenheim 119* (FM, MP, NY, US); Cayenne, 1819, *Martin s.n.* (B, MP); data incomplete, 1820, *Perrottet s.n.* (MP); 1862–64, *Melinon s.n.* (B, MP).

BRAZIL: PARA: Ilha das Onças, prope Belem do Para, ripis inundatis, Oct. 2, 1903, *Huber 21770* (B); Lago de Alter do Chão, prope Santarem, ripis arenosis, June 22, 1910, *Ducke 21772* (B); in ripis, Rio Oyapoc, June 4, 1904, *Ducke 21775* (B); Bôa Vista, on the Tapajos River, May–June, 1929, *Dahlgren & Sella 96* (FM); low and high land, Aramanahy, Jan. 11, 1932, *Costa 253* (FM, MBG); CEARA: data incomplete, 1842, *Gardner 951* (V); AMAZONAS: Barcellos, Rio Negro, ad rivulum silvestrem, June 13, 1905, *Ducke 21763* (B); Rio Purus, loco Bom Logar, May 14, 1904, *Huber 21762* (B); in fruticetis arenosis siccis ad Ega, Sept., 1831, *Poeppig 2547* (V); prope Panure, ad Rio Vaupes, Oct. 1852–Jan. 1853, *Spruce 2435* (B, Camb., G, MP, NY, V).

Monteiro da Costa reports that the wood of this species is used for fashioning small utensils, such as spoons, etc. It is said to be light and soft. Aublet reported his specific adjective derived from the vernacular name used by the Indians of French Guiana. Other names used by the native population of the species' area of distribution are said to be: "Oonsé balli"; "Jaramiloerang" (Dutch Guiana); "Molongo de Colher" (Para).

11. **Malouetia furfuracea** Spruce, ex Muell.-Arg. in Mart. Fl. Bras. 6^1: 93. 1860; Miers, Apoc. So. Am. 91. 1878.

Malouetia furfuracea Spruce β. *grandifolia* Muell.-Arg. loc. cit. 1860.

Shrubs (fide Ducke and Ule); stems relatively stout, glabrous, inconspicuously lenticellate when fully mature; leaves opposite, shortly petiolate, narrowly elliptic to broadly oblong-elliptic, apex obtusely subcaudate-acuminate, base obtuse to acute, 5–17 cm. long, 1.5–6.5 cm. broad, membranaceous, glabrous throughout, usually somewhat subnitidulous above, beneath opaque, foveate in the axils of the midrib; petioles 0.3–0.5 cm. long; umbels terminal, bearing relatively few white flowers; peduncle 0.2–0.4 cm. long; pedicels 0.8–2.0 cm. long, glabrous; calyx-lobes ovate, acute to acuminate, 0.3–0.5 cm. long, rather fleshy and coriaceous in texture, closely imbricated at anthesis, glabrous or minutely papillate without, papillate at the tips within, margins minutely ciliolate; corolla salverform, frequently somewhat inflated at the base, rather fleshy in texture, the tube 1.0–1.4 cm. long, about 0.1–0.125 cm. in diameter at the base, faucal tube 0.1–0.125 cm. long, about 0.15 cm. in diameter at the orifice, faucal annulus conspicuous, 5-lobed, glabrous without, minutely puberulent above within, the lobes obliquely ovate- or obovate-elliptic, obtuse to shortly acuminate, 1.3–2.3 cm. long, 0.3–0.45 cm. long, reflexed, papillate to puberulent-papillate without, minutely puberulent toward the base within; anthers conspicuously exserted, ovate-elliptic, 0.3–0.4 cm. long, minutely puberulent dorsally; ovary 0.1–0.125 cm. long, puberulent-papillate; stigma 0.1–0.15 cm. long; nectaries ½–⅔ equalling the ovary; follicles terete, 15–30 cm. long, 0.3–0.4 cm. in diameter, falcate, glabrous; seeds 0.35–0.4 cm. long, about 0.25–0.3 cm. in diameter, rather sparsely pilose or villous.

Dutch Guiana: fluv. Suriname sup., July 1, 1921, *Boschwesen 5302* (B, U); ad fl. Lawa, Sept., year lacking, *Kappler 2089* (B).

French Guiana: data incomplete, *Richard s.n.* (MP).

Brazil: para: Lago de Faro, ad ripas, Aug. 20, 1907, *Ducke 21774* (B); Rio Trombetas infer., ad ripas arenosas loco Caipuru, Sept. 16, 1910, *Ducke 21773* (B); rio de janeiro: data incomplete, *Glaziou 14082* (B); amazonas: Cachoeira Grande, bei Manãos, May, 1910, *Ule 8952* (B); am Strande, Rio Negro, Manãos, Jan., 1901, *Ule 5339* (B); in vicinibus Barra, April, 1851, *Spruce 1003* (B, type, M, NY, V, MBG, photograph and analytical drawings); ad oram meridionalem Rio

Negro, usque ad concursum flum. Solimoes, May, 1851, *Spruce 1566* (B, Camb., G, M, MP, NY, V); prope S. Gabriel do Cachoeira, ad Rio Negro, 1852, *Spruce 2305* (B, Camb., G, MP, NY, V).

The uncertainty which I have encountered in identifying specimens relegated to this species is decidedly conducive to the view that they may constitute merely a variety, or perhaps only a phase, of *M. Tamaquarina.* On the other hand, it cannot be denied that the seeds of the few available fruiting specimens are more or less villous, and that the follicles are somewhat more slender than those of *M. Tamaquarina.* The calyx-lobes alone are certainly insufficient evidence upon which to base the distinction of the species, as Markgraf has recently pointed out (in Pulle, Fl. Surinam **4**: 57. 1932). Nevertheless the latter author has maintained the specificity of *M. furfuracea.* The question is clearly one which will await solution by a student familiar with the plants in the field.

12. **Malouetia glandulifera** Miers, Apoc. So. Am. 90. *pl. 13A.* 1878.

Malouetia Tamaquarina A. DC. β *brasiliensis* Muell.-Arg. in Mart. Fl. Bras. **6**[1]: 92. 1860, not A. DC. as to specimens cited, in part.

Stems relatively stout, glabrous, inconspicuously lenticellate when fully mature; leaves opposite, shortly petiolate, oblong-oblanceolate, apex obtuse or rounded, base broadly acute to obtuse, 5–9 cm. long, 1.5–3.0 cm. broad, subcoriaceous, glabrous throughout, foveate in the axils of the midrib beneath; petioles 0.2–0.4 cm. long; umbels terminal, bearing 5–8 flowers; peduncle 0.2–0.3 cm. long; pedicels 1.3–2.0 cm. long, accrescent in fruit, glabrous; calyx-lobes ovate, broadly acute to obtuse, 0.15–0.175 cm. long, relatively fleshy in texture, closely imbricated at anthesis, generally puberulent-papillate within and without; corolla salverform, the tube 0.9 cm. long, about 0.1 cm. in diameter at the base, faucal tube 0.1 cm. long, about 0.15 cm. in diameter at the orifice, conspicuously annulate (the lobes in desiccation triangular, not divided), glabrous without, very minutely puberulent-papillate within, the lobes obliquely obovate-elliptic, acute, 1.5 cm. long, 0.4–0.5 cm. broad, reflexed, about uniformly papillate to glabrate within and without;

anthers rather inconspicuously exserted (in desiccation), ovate-elliptic, 0.25 cm. long, essentially glabrate dorsally; ovary 0.1 cm. long, minutely puberulent; stigma 0.075 cm. long; nectaries about ⅔ equalling the ovary; follicles terete, 8–10 cm. long, 0.35–0.4 cm. in diameter, divaricate, glabrous; seeds 2.0–2.5 cm. long, glabrous.

VENEZUELA: AMAZONAS: ad flumina Casiquiari, Vasiva et Pacimoni, 1853–4, *Spruce 3305* (B, Camb., G, NY, V, ISOTYPES, MBG, photograph and analytical drawings).

Although the status of this species is somewhat ambiguous in view of its poor representation in herbaria and the manifest variability of the closely neighboring *M. Tamaquaria* and *M. furfuracea*, it appears necessary to recognize it specifically because of its unusual foliage, almost uniformly papillate corolla-lobes, relatively deep insertion of anthers, and construction of the faucal annulus.

The nature of the faucal annulus itself is one which appears to have been widely misinterpreted in past literature. In inaugurating the genera *Malouetia* and *Robbia*, A. de Candolle made no reference to the annulus with regard to the former, on the other hand stating quite definitely (in DC. Prodr. **8**: 378. 1844) "fauce exappendiculata." With regard to the latter, the lobes were described, in part, as "basi intus in media parte calloso dentatis, appendicibus praetera nullis" [loc. cit. 445. 1844]. In 1860, however, Mueller consolidated *Malouetia* and *Robbia* and emended the description of the aggregate genus, including the phrase "Corolla . . . intus fauce 5-appendiculatus [tubus], appendiculae parvae subsquamulaeformes, lobis corollae oppositae [in Mart. Fl. Bras. **6**^{1}: 90. 1860]." Still later, Miers, usually an acute and intuitive observer, described the corolla-throat of *Malouetia* as "saepius squamulis 5 praeditus" [Apoc. So. Am. 86. 1878]; and later, with regard to *Robbia*, censures Delessert [Icon. **5**: *pl. 52.* 1846] for omitting to depict "the 5 scales which close the mouth of the corolla" of *R. cestroides* (Nees) A. DC. More recently, Schumann has spoken, with regard to *Malouetia* of the "Blkr. . . . in der Mitte verengter, am Schlunde 5–10 schuppiger Röhre" [in Engl. & Prantl, Nat. Pflanzenfam. **4**^{2}: 186. 1895]; and simi-

larly of "im Schlunde beschuppter Röhre" [loc. cit. 187. 1895] of the corolla of *Robbia.* Markgraf has maintained the traditional description of an appendiculate corolla in *Malouetia* by describing the throat as "closed by 5–10 short, triangular scales" [in Pulle, Fl. Surinam **4**: 57. 1932].

One might expect the "scales" of the corolla-throat of *Malouetia* to provide an easy criterion of specific entities, as those of *Prestonia,* for example, and such might be thought to be the case after only a few dissections. After many dissections, however, this hope fades. Not only is a striking variability found among individuals from specimens of the same collector's number, but a more significant phenomenon is found in recently collected specimens which upon careful soaking refuse to divulge the "squamulae" or "scales" at all! Almost exactly identical specimens, made by older collectors, however, usually demonstrate very pronounced "faucal scales."

The genus *Laubertia,* of the American Echitoideae, is typified in part by a corolline structure which appears in well-pressed specimens as a slightly thickened, but still membranaceous, ring or "annulus" at the orifice of the throat. *Prestonia* and *Rhodocalyx* are similarly provided. Quite recently Mr. William A. Schipp, of Stann Creek, British Honduras, has sent me a vial of alcoholic preservative containing several flowers of an apocynaceous genus which was at first examination a perplexing novelty. After careful scrutiny, however, it was recognized as a new species of *Laubertia.* The first failure of recognition was caused by the fact that the corolline orifice, which in well-desiccated material appears to have a well-defined membranaceous annulus, is in fresh material represented by a uniform, callose thickening of the orifice grading indefinitely into the more delicate texture of the corolla-tube and lobes. In other words, the faucal "ring," so manifest in exsiccatae, is not an artifact in itself, but its true nature is greatly altered in desiccation, caused by the drying and consequent collapse of the fleshy tissues of the orifice. Subsequent pressure completes the illusion of the membranaceous "annulus."

After examining a large series of specimens of *Malouetia* previously described as provided with five to ten "scales," a

similar interpretation to that arrived at with regard to *Laubertia* appears plausible. It is well to acknowledge, however, that if such be the case, wide knowledge of the living specimens, or at any rate liquid preserves, is necessary for accurate information. From an examination of numerous specimens of recent collection, in which the tissues are relatively resilient upon soaking and heating, it appears that the corolline orifice of *Malouetia* species, as in *Laubertia,* is rather uniformly thickened. The high insertion of the anthers, however, gives to the orifice a five-lobed contour. The anthers, which alternate with the corolla-lobes, also protrude beyond the faucal annulus in most species. These factors, together, would appear to be responsible for the configuration of the "squamulae" or "faucal scales" in material which has been long desiccated; whose tissues, as every systematic botanist can testify, have consequently lost their earlier powers of resilience.

In *Malouetia glandulifera* the "faucal scales" of the herbarium material available (collected in 1853–54) are definitely acute-triangular, entire, and quite unlike those of *M. Tamaquarina* specimens of comparable age, which are broader, lower, rounded, and usually more or less bifid. It is not meant to imply that faucal differences do not exist between these two species: such is probably the case. Nevertheless it will probably be agreed that difficulty would be encountered in an attempt either to reconstruct the living condition from the desiccated, or to recognize the living from a description of the desiccated.

13. Malouetia peruviana Woodson, spec. nov.

Arbuscula (3–7 m. alta, fide Klug); ramulis teretibus crassiusculis glaberrimis maturitate inconspicue lenticellatis; foliis oppositis breviter petiolatis anguste oblongo- vel ovato-ellipticis aut acute aut subcaudate acuminatis 5–20 cm. longis 1.5–8.5 cm. latis subcoriaceis glaberrimis supra subnitidulis subtus opacis in axillis nervi medii conspicuissime foveatis; petiolis 0.3–0.5 cm. longis; umbellis terminalibus flores 3–8 viridi-albidas gerentibus; pedunculo 0.2–0.5 cm. longo; pedicellis 1.0–1.5 cm. longis glaberrimis; calycis laciniis ovatis

obtusis vel late acutis 0.25–0.4 cm. longis subcoriaceis valde imbricatis extus intusque minutissime papillatis glabratisve; corollae salverformis cereolae tubo 1.2–1.5 cm. longo basi ca. 0.15–0.3 cm. diametro metiente supra saepius paululo dilatato faucibus tubulari-campanulatis ca. 0.1 cm. longis ostio ca. 0.25–0.3 cm. diametro metiente ibique conspicue calloso-annulato extus glabro intus prope insertionem staminum minute puberulo-papillato lobis oblique ovato- vel obovato-ellipticis acutis 1.2–1.7 cm. longis 0.5–0.7 cm. latis patentibus intus extusque minute papillatis glabratisve; antheris conspicue exsertis ovato-ellipticis 0.4–0.5 cm. longis, glabris glabratisve; ovario 0.15 cm. longo minute puberulo; stigmate 0.15 cm. longo; nectariis ovarium ½–⅔ aequantibus; folliculis ignotis.

Small trees (3–7 m. tall, fide Klug); stems terete, relatively stout, glabrous, inconspicuously lenticellate when fully mature; leaves opposite, shortly petiolate, lance- to ovate-elliptic, apex acutely and frequently subcaudate-acuminate, 5–20 cm. long, 1.5–8.5 cm. broad, subcoriaceous, glabrous throughout, above somewhat subnitidulous, beneath opaque, very conspicuously foveate in the axils of the midrib; petioles 0.3–0.5 cm. long; umbels terminal, bearing 3–8 greenish-white flowers; peduncle 0.2–0.5 cm. long; pedicels 1.0–1.5 cm. long, glabrous; calyx-lobes ovate, obtuse to broadly acute, 0.25–0.4 cm. long, subcoriaceous, closely imbricated at anthesis, minutely papillate to glabrate throughout; corolla salverform, rather thick and waxy in texture, the tube 1.2–1.5 cm. long, about 0.15–0.3 cm. in diameter at the base, very slightly dilated above if at all, faucal tube campanulate, 0.1 cm. long, about 0.25–0.3 cm. in diameter at the orifice, conspicuously callose-annulate, glabrous without, minutely puberulent-papillate within toward the insertion of the stamens, the lobes obliquely ovate- or obovate-elliptic, acute, 1.2–1.7 cm. long, 0.5–0.7 cm. broad, reflexed, about uniformly papillate to glabrate within and without; anthers conspicuously exserted, ovate-elliptic, 0.4–0.5 cm. long, glabrous to glabrate; ovary 0.15 cm. long, minutely puberulent; stigma 0.15 cm. long; nectaries about ½–⅔ equalling the ovary; follicles unknown.

PERU: LORETO: woods, Iquitos, alt. about 100 m., Aug. 3–11, 1929, *Killip & Smith 27004* (FM, MBG, TYPE, NY, US); Aug. 2–8, 1929, *Killip & Smith 27371* (MBG, NY, US); Mishuyacu, near Iquitos, forest, alt. 100 m., Febr.–March, 1930, *Klug, 972* (FM, NY, US); Caballo-Cocha, on the Amazon River, Aug., 1929, *Williams 2089* (FM, MBG); Timbuchi, on the Rio Nanay, June–July, 1929, *Williams, 928* (FM, MBG); *Williams 973* (FM, MBG).

There can be little doubt that this species is distinct from *M. Tamaquarina* and *M. furfuracea* for which it has previously been mistaken. Its salient characteristic, as indicated in the key to species, are supplemented by many minor ones which may be detected through a comparison of the foregoing descriptions.

14. **Malouetia amplexicaulis** Muell.-Arg. in Mart. Fl. Bras. **6**^{1}: 91. 1860; Miers, Apoc. So. Am. 91. 1878; K. Sch. in Engl. & Prantl, Nat. Pflanzenfam. **4**^{2}: 187. 1895.

Stems relatively stout, glabrous, rather inconspicuously lenticellate when fully mature; leaves opposite, sessile or subsessile, appearing more or less amplexicaul, broadly oblong-elliptic, apex obtusely, and almost subcaudately, acuminate, base obtuse to rounded, or slightly cordate, 9–23 cm. long, 3.5–10 cm. broad, firmly membranaceous, glabrous throughout, somewhat subnitidulous above, beneath opaque and rather inconspicuously foveate in the axils of the midrib; umbels terminal, relatively few-flowered; peduncle 0.15–0.4 cm. long; pedicels 1.0–1.5 cm. long, glabrous; calyx-lobes ovate, obtuse, 0.2–0.3 cm. long, somewhat subcoriaceous, closely imbricated at anthesis, minutely papillate within and without; corolla salverform, the tube 1.2–1.3 cm. long, about 0.125 cm. in diameter at the base, faucal annulus about 0.075 cm. long, about 0.15 cm. in diameter at the orifice, conspicuously callose-annulate, glabrous without, minutely puberulent within toward the insertion of the stamens, the lobes obliquely and broadly oblong-elliptic, obtuse to acute, 0.8–0.9 cm. long, reflexed, very minutely and indefinitely papillate without, minutely puberulent or puberulent-papillate within; anthers conspicuously exserted, oblong-elliptic, 0.3–0.35 cm. long, minutely puberulent dorsally; ovary 0.1 cm. long, densely puberulent-papillate; stigma 0.075 cm. long; nectaries about ½ equalling the ovary; follicles unknown.

BRAZIL: AMAZONAS: prope Panure ad Rio Vaupes, Oct. 1852–Jan. 1853, *Spruce 2595* (Camb., G, MP, NY, V, ISOTYPES, MBG, photograph and analytical drawings).

The chief, if not the only, distinction of *M. amplexicaulis* appears to be the rather large, nearly sessile and amplexicaul foliage. However, but a single collection is known to us, and this, together with the fact that all specimens are rather meagre, renders the status of the species somewhat dubious. It is to be hoped that the renewed botanical activity in the upper Amazon Valley may lead to the rediscovery of this interesting plant.

15. **Malouetia Killipii** Woodson, Ann. Mo. Bot. Gard. **18:** 551. 1931.

Small trees (5–10 m. tall, fide Klug; Killip & Smith); stems relatively stout, terete, minutely puberulent when very young, soon becoming glabrate, rather inconspicuously lenticellate when fully mature; leaves opposite, shortly petiolate, narrowly oblong- to broadly ovate-elliptic, apex obtusely and narrowly subcaudate-acuminate, base obtuse to rounded, 15–25 cm. long, 5–12 cm. broad, membranaceous, above somewhat subnitidulous, glabrous, beneath densely and minutely velutinous-puberulent; petioles 0.3–0.7 cm. long; umbels terminal, infrequently lateral as well, bearing several greenish-white flowers; peduncle 0.3–0.5 cm. long; pedicels 0.5–1.0 cm. long, very minutely papillate to essentially glabrous; calyx-lobes ovate, obtuse to broadly acute, 0.15–0.25 cm. long, somewhat subcoriaceous, closely imbricated at anthesis, minutely papillate within and without; corolla salverform, somewhat thick and waxy in texture, the tube 1.1–1.2 cm. long, about 0.1 cm. in diameter at the base, faucal tube 0.1 cm. long, about 0.15–0.2 cm. in diameter at the orifice, conspicuously callose-annulate, glabrous to minutely papillate without, minutely puberulent within toward the insertion of the stamens, the lobes obliquely ovate, acute to obtuse, 0.9–1.2 cm. long, 0.35–0.5 cm. broad, reflexed, papillate without, minutely puberulent within toward the base; anthers conspicuously exserted, ovate-elliptic, 0.25–0.3 cm. long, minutely puberulent dorsally; ovary 0.1 cm. long, minutely puberulent; stigma 0.15 cm. long; nectaries ½–¾ equalling the ovary; follicles unknown.

PERU: LORETO: woods, Iquitos, alt. about 100 m., Sept. 26, 1929, *Killip & Smith 29860* (FM, MBG, TYPE, NY, US); forest, Mishuyacu, near Iquitos, alt. 100 m., Oct.–Nov., 1929, *Klug 79* (B, FM, US).

Sect. 2. GRACILES Woodson. Corolla-tube cylindrical, abruptly constricted at the insertion of the stamens; anthers narrowly oblong- to linear-elliptic, wholly included, inserted about midway or deeper within the corolla-tube. *Spp. 16–20.*

KEY TO THE SPECIES

a. Corolla-tube 0.7–1.5 cm. long; species of eastern tropical South America.
  b. Corolla-lobes ovate-oblong; ovary glabrous; plants of British Guiana.... ....*16. M. gracilis*
  bb. Corolla-lobes linear to oblong-lanceolate; ovary pubescent; species of northern Brazil.
    c. Corolla-lobes about as long as the tube or somewhat shorter; stamens inserted at somewhat below midway within the corolla-tube.
      d. Corolla-lobes oblong- to ovate-lanceolate; corolla-tube not narrowing toward the orifice; anthers glabrous; leaves coriaceous or subcoriaceous..*17. M. virescens*
      dd. Corolla-lobes linear-lanceolate; corolla-tube extremely slender, narrowing toward the orifice; anthers minutely pilosulose; leaves delicately membranaceous..........................*18. M. gracillima*
    cc. Corolla-lobes about twice as long as the tube, or nearly so; stamens inserted about midway within the corolla-tube..............*19. M. nitida*
aa. Corolla-tube 0.4–0.55 cm. long; plants of Central America..*20. M. guatemalensis*

16. Malouetia gracilis (Benth.) A. DC. in DC. Prodr. **8**: 380. 1844; Miers, Apoc. So. Am. 87. 1878; K. Sch. in Engl. & Prantl, Nat. Pflanzenfam. **4**^{2}: 187. 1895.

Tabernaemontana gracilis Benth. in Hook. Jour. Bot. **3**: 244. 1841.

Stems relatively slender, terete, glabrous, rather inconspicuously lenticellate when fully mature; leaves opposite, shortly petiolate, oblong-elliptic, apex acuminate, base obtuse, 3.5–8.0 cm. long, 1–3 cm. broad, membranaceous, glabrous throughout, above subnitidulous, beneath opaque, pallid; petioles 0.3–0.5 cm. long, glabrous; umbels terminal, few-flowered; peduncle 0.1–0.3 cm. long; pedicels 0.3–0.5 cm. long, glabrous; calyx-lobes ovate, acute, closely imbricated, 0.225–0.25 cm. long, glabrous without, minutely puberulent-papillate within toward the tips; corolla salverform, the tube cylindrical, abruptly constricted at the insertion of the stamens, 1.4–1.5 cm. long, about

0.125 cm. in diameter at the base, about 0.15 cm. in diameter at the orifice, glabrous without, minutely puberulent within above the insertion of the stamens, somewhat callose-thickened generally above the insertion of the stamens (appearing as 5–10 linear welts in desiccation), the lobes ovate-oblong, acute, 0.9–1.0 cm. long, densely puberulent-papillate without and within, widely spreading; anthers included, inserted at somewhat below midway within the corolla-tube, narrowly oblong- to linear-elliptic, 0.35 cm. long, glabrous; ovary 0.1 cm. long, glabrous; stigma 0.075 cm. long; nectaries about ½ equalling the ovary; follicles terete, relatively short and stout, 5.0–5.5 cm. long, rigidly divaricate, glabrous; seeds 0.7–0.9 cm. long, glabrous.

BRITISH GUIANA: upper Essequibo River, Jan., 1842, *Schomburgk 39* (B, Camb., G, NY, ISOTYPES, MBG, photograph and analytical drawings).

17. Malouetia virescens Spruce, ex Muell.-Arg. in Mart. Fl. Bras. **6**[1]: 92. 1860; Miers, Apoc. So. Am. 90. 1878; K. Sch. in Engl. & Prantl, Nat. Pflanzenfam. **4**[2]: 187. 1895.

Small trees (according to Ducke); stems relatively stout, terete, glabrous, rather inconspicuously lenticellate when fully mature; leaves opposite, shortly petiolate, oblong-elliptic, apex acute to obtuse, base obtuse to broadly acute, 4.5–10.0 cm. long, 1.5–3.0 cm. broad, coriaceous or subcoriaceous, glabrous throughout, nitidulous above, opaque and inconspicuously foveate in the axils of the midrib beneath; petioles 0.3–0.4 cm. long; umbels terminal, few-flowered; peduncle 0.1–0.2 cm. long; pedicels 0.5–0.8 cm. long, glabrous; calyx-lobes ovate, broadly obtuse, 0.125–0.2 cm. long, somewhat coriaceous, closely imbricated at anthesis, glabrous without, very minutely and indefinitely papillate within; corolla salverform, the tube cylindrical, abruptly constricted at the insertion of the stamens, 0.8–1.0 cm. long, about 0.1 cm. in diameter at the base, about 0.125–0.15 cm. in diameter at the orifice, somewhat callose-thickened generally in the region of the orifice (appearing as 5–10 linear welts in desiccation), glabrous without, minutely and indefinitely papillate above the insertion of the stamens within, the lobes oblong- to ovate-lanceolate, acute, 0.7–1.1 cm. long, 0.25–0.3 cm. broad, widely spreading, minutely papillate

to essentially glabrous without, puberulent-papillate toward the base within; anthers included, inserted somewhat below midway within the corolla-tube, narrowly oblong- to linear-elliptic, 0.325–0.375 cm. long, glabrous or essentially so; stigma 0.15 cm. long; ovary 0.1 cm. long, very minutely puberulent; nectaries about ½ equalling the ovary; follicles unknown.

BRAZIL: AMAZONAS: prope Panure ad Rio Vaupes, Oct. 1852–Jan. 1853, *Spruce 2472* (B, TYPE, Camb., G, NY, MBG, photograph and analytical drawings); Rio Curicuriary, affl. R. Negro super., in ripis profunde inundatis, Dec. 23, 1931, *Ducke 23956* (B).

18. **Malouetia gracillima** Woodson, spec. nov.

Ramulis teretibus gracilibus glaberrimis; foliis oppositis petiolatis ellipticis apice acute obtuseve acuminatis basi obtusis 5–10 cm. longis 2.8–4.0 cm. latis tenuiter membranaceis omnino glaberrimis supra nitidis et eleganter venosis subtus opacis in axillis nervi medii obscure foveatis; petiolis 0.3–0.6 cm. longis; umbellis et terminalibus et lateralibus flores paucas parvas gracillimas gerentibus; pedunculo 0.1–0.15 cm. longo; pedicellis 0.4–0.6 cm. longis glabris; calycis laciniis ovatis vel ovato-lanceolatis acutis 0.09–0.15 cm. longis extus intusque minute puberulo-papillatis margine ciliolatis; corollae graciliter salverformis tubo 1.0–1.1 cm. longo basi ca. 0.1 cm. diametro metiente faucibus ca. 0.125 cm. diametro metientibus vix incrassatis extus glabro intus prope fauces minute puberulo-papillato lobis oblique lineari-lanceolatis acuminatis 0.8–1.0 cm. longis 0.08–0.1 cm. latis extus minute papillatis intus basi puberulo-papillatis patulis; antheris inclusis paulo sub medio corollae tubi insertis lineari-ellipticis 0.3 cm. longis sparse minutissimeque pilosulis; ovario 0.05 cm. longo minutissime puberulo; stigmate 0.1 cm. longo; nectariis ovario multo brevioribus; folliculis ignotis.

Stems terete, relatively slender, glabrous; leaves opposite, petiolate, elliptic, apex acutely or obtusely acuminate, base obtuse, 5–10 cm. long, 2.8–4.0 cm. broad, delicately membranaceous, glabrous throughout, nitid and elegantly veined above, beneath opaque, obscurely foveate in the axils of the midrib; petioles 0.3–0.6 cm. long; umbels both terminal and lateral,

bearing relatively few, small, graceful flowers; peduncle 0.1–0.15 cm. long; pedicels 0.4–0.6 cm. long, glabrous; calyx-lobes ovate or ovate-lanceolate, acute, 0.09–0.15 cm. long, minutely puberulent-papillate without and within, the margin ciliolate; corolla gracefully salverform, the tube 1.0–1.1 cm. long, about 0.1 cm. in diameter at the base, about 0.125 cm. in diameter at the orifice, abruptly constricted at the insertion of the stamens, glabrous without, minutely puberulent-papillate toward the throat, the lobes obliquely linear-lanceolate, acuminate, 0.8–1.0 cm. long, about 0.08–0.1 cm. broad, minutely papillate without, puberulent-papillate toward the base within, spreading; anthers included, inserted somewhat below midway within the corolla-tube, narrowly oblong- or linear-elliptic, 0.3 cm. long, sparsely and minutely pilosulose dorsally; ovary 0.05 cm. long, very minutely puberulent; stigma 0.1 cm. long; nectaries much shorter than the ovary (scarcely manifest); follicles unknown.

Brazil: amazonas: Lages, April 8, 1879, *Traill 517* (G, type, K, MBG, photograph and analytical drawings).

This is the most distinctive of the South American species of sect. *Graciles,* and is unmistakable because of its extremely narrow corolla-tube. Traill reports the plant as the "Ygapo tree."

19. Malouetia nitida Spruce, ex Muell.-Arg. in Mart. Fl. Bras. **6**[1]: 94. 1860; Miers, Apoc. So. Am. 91. 1878.

Stems relatively stout, terete, glabrous, greyish-brown, rather inconspicuously lenticellate when fully mature; leaves opposite, shortly petiolate, oblong-elliptic, apex acutely acuminate, base obtuse to rounded, 8–15 cm. long, 3–6 cm. broad, membranaceous, glabrous throughout, nitid above, beneath opaque, obscurely and rather infrequently foveate in the axils of the midrib; petioles 0.2–0.5 cm. long; umbels terminal, occasionally lateral as well, bearing several flowers; peduncle 0.3–0.5 cm. long; pedicels 1.2–1.5 cm. long, glabrous; calyx-lobes ovate, acute, 0.2–0.25 cm. long, minutely puberulent-papillate at the tips without and within, otherwise essentially glabrous; corolla salverform, the tube cylindrical, abruptly constricted at the insertion of the stamens, 0.7–0.75 cm. long, about

0.125 cm. in diameter at the base and orifice, very indefinitely papillate without, minutely papillate to puberulent-papillate within toward the throat, the lobes linear-oblong, acute to acuminate, 1.3–1.4 cm. long, widely spreading to reflexed, glabrous without, minutely puberulent toward the base within; anthers included, inserted at about midway within the corolla-tube, linear-elliptic, 0.3 cm. long, essentially glabrous; ovary 0.1 cm. long, minutely puberulent-papillate; stigma 0.12 cm. long; nectaries about ½ equalling the ovary; follicles unknown.

BRAZIL: AMAZONAS: prope Barra, Prov. Rio Negro, Aug., 1851, *Spruce 1672* (B, Camb., G, ISOTYPES, MBG, photograph and analytical drawings).

20. **Malouetia guatemalensis** (Muell.-Arg.) Standl. Jour. Wash. Acad. Sci. **15**: 459. 1925.

Stemmadenia guatemalensis Muell.-Arg. Linnaea **30**: 410. 1860.

Malouetia panamensis Heurck & Muell.-Arg. in Heurck, Obs. Bot. 185. 1871.

Small trees (5–10 m. tall, fide Pittier; "large trees," fide Schipp); stems relatively stout, terete, reddish-brown, glabrous, inconspicuously lenticellate when fully mature; leaves opposite, petiolate, oblong- to ovate-elliptic, obtusely subcaudate-acuminate, base obtuse, 6–25 cm. long, 2–10 cm. broad, firmly membranaceous, glabrous throughout, somewhat nitidulous above, beneath opaque, conspicuously foveate in the axils of the midrib; petioles 0.5–1.0 cm. long, glabrous; umbels terminal, frequently lateral as well, bearing relatively numerous small, greenish-white flowers; peduncle 0.1–0.3 cm. long; pedicels 0.3–0.5 cm. long, glabrous or very minutely papillate; calyx-lobes ovate, acute to obtuse, subcoriaceous, closely imbricated, 0.15–0.25 cm. long, minutely puberulent-papillate within and without; corolla salverform, the tube abruptly constricted at the insertion of the stamens, somewhat inflated above the base, 0.4–0.55 cm. long, about 0.125–0.15 cm. in diameter at the base, orifice about 0.15 cm. in diameter, callose-thickened (appearing as 5 linear, double welts in desiccated material), glabrous without, or minutely papillate toward the orifice, essentially glabrous within, the lobes obliquely lanceo-

late- to ovate-oblong, acuminate, 0.7–1.2 cm. long, 0.2–0.3 cm. broad, widely spreading, puberulent-papillate within, papillate without; anthers included, inserted slightly below midway within the corolla-tube, narrowly oblong-elliptic, 0.2 cm. long, very minutely puberulent-papillate dorsally; ovary 0.1 cm. long, minutely papillate; stigma 0.075 cm. long; nectaries ½ to about equalling the ovary; follicles stout, fusiform, rigidly divaricate, 10–13 cm. long, 1–2 cm. in diameter, glabrous; seeds 2.5–3.0 cm. long, glabrous.

BRITISH HONDURAS: brackish swamps, South Stann Creek, Sept. 17, 1930, *Schipp 653* (B, FM, MBG, NY); data incomplete, *Peck 671* (B).

GUATEMALA: IZABAL: Mniogalpa, 1841, *Friedrichsthal 138* (V, TYPE, MBG, photograph and analytical drawings); Livingston, June, 1906, *Tuerckheim II 1233* (FM, US); same locality, Febr. 17, 1905, *Deam s.n.* (NY, US).

HONDURAS: ATLANTIDA: vicinity of Tela, at sea-level, Dec. 14–March 15, 1928, *Standley 54737* (FM, US); forest trail west of Tela River, Puerto Sierra, Febr. 15, 1903, *Wilson 422* (FM, NY, US).

NICARAGUA: data incomplete, *Wright s.n.* (B, US).

COSTA RICA: LIMON: Cienequita, près Limon, litt. Atlantique, July, 1911, *Pittier 16137* (B).

PANAMA: BOCAS DEL TORO: Laguna de Chiriqui and its neighborhood, Nov.–Dec., 1885, *Hart 128* (US); Changuinola Valley, 1927, *Cooper & Slater 113* (FM, US); CANAL ZONE: wooded swamp, common, between France Field and Catival, Prov. of Colon, Jan. 9, 1924, *Standley 30184* (US); near Fort Randolph, swampy woods, common, Dec. 28, 1923, *Standley 28636* (US); in low, wet woods near Frijoles Sta., P. R. R., Febr., 1861, *Hayes 55* (B, G); Chagres, Jan.–March, 1850, *Fendler 184* (MBG, US); forest along the Rio Indio de Gatun, near sea-level, Febr. 17, 1911, *Pittier 2813* (FM, NY, US); around Frijoles, in forest and thickets, alt. 25–30 m., July 1, 1911, *Pittier 3752* (NY, US).

This truly distinctive species is probably entitled to sectional rank in the genus *Malouetia,* because of its large, fusiform follicles and peculiar corolla-tube construction. It is difficult to base classification of the genus upon fruit characters at the present time, however, as follicles are unknown for certain of the species, as has already been indicated. Although seemingly distant from the South American species, the relationships of *M. guatemalensis* are evidently most closely with those of sect. *Graciles,* as evidenced not only by the deep insertion of the anthers, but the character of the callose thickening of the corolla throat as well.

EXCLUDED OR UNCERTAIN SPECIES

Malouetia asiatica Sieb. & Zucc. Abh. Akad. München **4**^{3}: 163. 1846 = **Trachelospermum asiaticum** (Sieb. & Zucc.) Nakai, in Mori, Pl. Cor. 293. 1922.

Malouetia guianensis Klotzsch, in Schomb. Faun. & Fl. Guian. 952. 1841, nom. nud. This may possibly refer to *Cameraria Guyanensis* Aubl. Hist. Pl. Gui. Fr. **1**: 262. 1775, which is synonymous with **Malouetia Tamaquarina** (Aubl.) A. DC. in DC. Prodr. **8**: 378. 1844.

Malouetia jasminoides HBK. Nov. Gen. **3**: 226. 1819 = **Tabernaemontana amygdalifolia** Jacq. Select. Stirp. Am. Hist. **1**: 39. *pl. 181. fig. 15.* 1763.

Malouetia lactiflua Miers, Apoc. So. Am. 88. 1878. Based upon *Schomburgk 168.* Impressed by the notation of the collection with regard to a milky exudation, Miers expressed the unequivocable interpretation of it as a *Malouetia.* The specimen is fragmentary and vegetative only, and as the leaves show no indication of the familiar foveae in the axils of the midrib beneath, its relegation to an undetermined species of *Zschokkea* by Sandwith (in herb. Kew.) appears far better substantiated by our present knowledge than that of Miers.

Malouetia puberula Klotzsch, in Schomb. loc. cit. 1841, nom. nud.

Malouetia riparia (HBK.) A. DC. loc. cit. 380. 1844 (*Tabernaemontana riparia* HBK. loc. cit. 228. 1819) = **Stemmadenia grandiflora** (Jacq.) Miers, loc. cit. 75. 1878 (*Tabernaemontana grandiflora* Jacq. Enum. Pl. Carib. 14. 1760).

Malouetia ? sessilis (Vell.) Muell.-Arg. in Mart. Fl. Bras. **6**^{1}: 96. 1860 (*Echites sessilis* Vell. Fl. Flum. 111. 1830; Icon. **3**: *pl. 35.* 1827). The plate cited indicates the plant to be a liana. Since no characters of a *Malouetia* are indicated save a sessile, umbellate inflorescence and exserted anthers of a small flower, it appears impossible to hazard a suggestion concerning the generic affinities of this species.

Malouetia tetrastachya (HBK.) Miers, loc. cit. 92. 1878 = **Tabernaemontana tetrastachya** HBK. loc. cit. 227. 1819.

Robbia macrocarpa (Rich.) Miers, loc. cit. 108. 1878 (*Echites

? *macrocarpa* Rich. Fl. Cub. **2**: 86. 1853, not Wall.) = **Catalpa macrocarpa** (Rich.) Ekman, in Urb. Symb. Ant. **9**: 254. 1924.

IX. ODONTADENIA Benth.

Odontadenia Benth. in Hook. Jour. Bot. **3**: 242. 1841; A. DC. in DC. Prodr. **8**: 359. 1844; Muell.-Arg. in Mart. Fl. Bras. **6**^{1}: 116. 1860; Benth. & Hook. Gen. Pl. **2**: 723. 1876; Miers, Apoc. So. Am. 126. 1878; K. Sch. in Engl. & Prantl, Nat. Pflanzenfam. **4**^{2}: 169. 1895.

Anisolobus A. DC. loc. cit. 395. 1844; Muell.-Arg. loc. cit. 110. 1860; Miers, loc. cit. 168. 1878.

Cylicadenia Lem. in Van Houtte, Illustr. Hort. **2**: Misc. 9. 1855.

Angadenia Miers, loc. cit. 173. 1878, in part.

Perictenia Miers, loc. cit. 182. 1878.

Mitozus Miers, loc. cit. 217. 1878, in part.

Codonechites Mgf. Notizblatt **9**: 80. 1924.

Echites of early authors, in part, not P. Br.

Lactescent, fruticose or suffruticose lianas, very rarely becoming suberect. Stems volubile, terete, the branches opposite, or opposite below becoming alternate above. Leaves opposite, entire, penninerved, eglandular; nodes stipulate or exstipulate. Inflorescence lateral, or both terminal and lateral, thyrsiform to simply scorpioid, bracteate, multiflorous to subuniflorous. Calyx 5-parted, the lobes essentially equal to conspicuously unequal, cleft nearly to the receptacle, imbricated, bearing within 5 to many alternate or indefinitely distributed squamellae. Corolla infundibuliform or infrequently salverform, the tube straight or very slightly gibbous, exappendiculate within, the limb actinomorphic, 5-parted, dextrorsely convolute. Stamens 5, the anthers connivent and agglutinated to the stigma, consisting of 2 parallel sporangia borne ventrally near the apex of an enlarged, sagittate, narrowly 2-lobed, peltate connective; pollen granular; filaments short, subcylindrical, usually densely pilosulose. Carpels 2, united at the apex by a common stylar shaft surmounted by the fusiform or subcapitate, inconspicuously maniculate or 5-digitate stigma;

ovules many, several-seriate, borne upon an axile, binate placenta. Nectaries 5, usually concrescent, rarely more or less separate. Follicles 2, apocarpous, terete or more or less flattened laterally, dehiscing along the ventral suture, containing many dry, truncate, apically comose seeds.

Type species: *Odontadenia Hoffmannseggiana* (Steud.) Woodson, in Gleason & A. C. Smith, Bull. Torrey Bot. Club **60**: 392. 1933.

KEY TO THE SUBGENERA AND SECTIONS

A. Inflorescence thyrsiform; calyx-lobes unequal; stipules present, caducous; stems conspicuously lenticellate at maturity........Subgen. I. ANISOLOBUS

B. Corolla definitely infundibuliform, the throat conspicuously dilated (except in *O. gracilipes*); stipules 2, laminate, scarious...Sect. 1. VERRUCOSAE

BB. Corolla salverform to subsalverform, the tube dilating but slightly; stipules several, filiform, subfoliaceous...............Sect. 2. ANOMALAE

AA. Inflorescence not thyrsiform; calyx-lobes essentially equal; stipules absent or extremely indefinite; stems not lenticellate, or very inconspicuously so above..................................Subgen. II. EUODONTADENIA

B. Corolla 2.5–8 cm. long; stigma fusiform, frequently maniculate.

C. Inflorescence both terminal and lateral; nectary deeply and indefinitely multifid; anthers densely hirsutulose dorsally...Sect. 3. HOFFMANNSEGGIANAE

CC. Inflorescence lateral; nectary 5-lobed, the divisions entire or merely crenulate; anthers glabrous to puberulent-papillate dorsally...Sect. 4. NITIDAE

BB. Corolla 1.8–2.1 cm. long; stigma subcapitate, digitate...Sect. 5. LAXIFLORAE

Subgen. I. ANISOLOBUS (A. DC.) Woodson, comb. nov.

Anisolobus A. DC. in DC. Prodr. **8**: 395. 1844; Muell.-Arg. in Mart. Fl. Bras. **6**[1]: 110. 1860; Miers, Apoc. So. Am. 168. 1878, pro gen.

Corolla-tube straight, or slightly gibbous or arcuate; calyx-lobes unequal, the outer shorter and broader than the inner; inflorescence thyrsiform; stipules present, interpetiolar, caducous; stems conspicuously lenticellate. *Sects. 1–2.*

Sect. 1. VERRUCOSAE Woodson. Corolla definitely infundibuliform, the throat conspicuously and abruptly dilated (except in *O. gracilipes* where subsalverform); inflorescence terminal, or both terminal and lateral, the subtending leaves opposite; stipules 2, laminate, scarious. *Spp. 1–17.*

KEY TO THE SPECIES

a. Corolla infundibuliform.
 b. Stamens inserted within the corolla-tube proper below the dilation of the throat.
  c. Calyx-lobes 0.5–0.9 cm. long.
   d. Corolla densely and minutely velutinous-papillate without, at least in the bud..*1. O. cognata*
   dd. Corolla glabrous without, very rarely with inconspicuous, scattering trichomes.
    e. Corolla-throat about 1.5 cm. in diameter, abruptly dilating from the proper tube.................................*2. O. funigera*
    ee. Corolla-throat 0.3–0.7 cm. in diameter, gradually dilating from the proper tube.
     f. Corolla-throat 2.6–3.0 cm. long, 0.3–0.4 cm. in diameter, the lobes 0.7–0.9 cm. long; leaves 12–15 cm. long.........*3. O. surinamensis*
     ff. Corolla-throat 1.9–2.1 cm. long, 0.7 cm. in diameter, the lobes 1.8–2.0 cm. long; leaves 6–10 cm. long..............*4. O. neglecta*
  cc. Calyx-lobes 0.2–0.55 cm. long.
   d. Leaves not cordate; nectary fleshy, essentially entire or obscurely and irregularly 5-cleft, or multifid.
    e. Corolla densely and minutely velutinous-papillate without, at least in the bud.....................................*5. O. verrucosa*
    ee. Corolla glabrous without.
     f. Inflorescence lateral; corolla-throat narrowly conical, about 0.55 cm. in diameter............................. *6. O. affinis*
     ff. Inflorescence terminal; corolla-throat broadly conical, about 1 cm. in diameter.................................*7. O. Killipii*
   dd. Leaves obscurely cordate; nectary membranaceous, conspicuously 2-lobed...*8. O. cordigera*
 bb. Stamens inserted at the base of the corolla-throat.
  c. Corolla-throat campanulate to conical-campanulate; leaves frequently obscurely cordate...*9. O. lutea*
  cc. Corolla-throat tubular to subtubular; leaves never cordate.
   d. Corolla minutely velutinous-papillate without, at least in the bud.
    e. Leaves glabrous throughout.....................*10. O. puncticulosa*
    ee. Leaves minutely tomentulose beneath..................*11. O. spoliata*
   dd. Corolla glabrous without.
    e. Calyx-lobes as long as the corolla-tube proper, or nearly so...... ....*12. O. Perrottetii*
    ee. Calyx-lobes manifestly shorter than the corolla-tube proper.
     f. Calyx glabrous without......................*13. O. Sandwithiana*
     ff. Calyx more or less densely puberulent-papillate without.
      g. Outer calyx-lobes nearly equalling the inner, the latter about ½ the length of the corolla-tube proper; species of South America.
       h. Inflorescence terminal, many-flowered (30–50); corolla-throat about 3.5 cm. long..................*14. O. lauretiana*

hh. Inflorescence lateral, few-flowered (2–6); corolla-throat 2.0–2.6 cm. long .... *15. O. Kochii*

gg. Outer calyx-lobes much shorter than the inner, the latter about ⅔ the length of the corolla-tube proper; plants of British Honduras .... *16. O. Schippii*

aa. Corolla subsalverform .... *17. O. gracilipes*

1. Odontadenia cognata (Stadelm.) Woodson, Ann. Mo. Bot. Gard. **18**: 546. 1931.

Echites cognata Stadelm. Flora **24**[1]: Beibl. 79. 1841; A. DC. in DC. Prodr. **8**: 470. 1844.

Anisolobus cognatus (Stadelm.) Muell.-Arg. in Mart. Fl. Bras. **6**[1]: 113. 1860.

Angadenia cognata (Stadelm.) Miers, Apoc. So. Am. 176. 1878.

Odontadenia augusta Woodson, loc. cit. 548. 1931.

Stems relatively stout, dull reddish-brown, finely puberulent-papillate when young, glabrate and conspicuously lenticellate when fully mature; leaves opposite, petiolate, broadly elliptic to oblong-elliptic, occasionally to obovate-elliptic, apex acute to acuminate, base obtuse to attenuate, 8–17 cm. long, 3–9 cm. broad, firmly membranaceous to chartaceous, either surface glabrous, opaque; petioles 0.9–2.0 cm. long; stipules 2, ovate-trigonal, acuminate, 0.3–0.4 cm. long, scarious, caducous; inflorescence corymbose-thrysiform, terminal, about equalling or somewhat surpassing the subtending leaves, bearing 20–50 yellow, reddish-tinged flowers; pedicels 1.0–1.5 cm. long, somewhat accrescent in fruit, densely and minutely puberulent; bracts ovate-trigonal 0.2–0.4 cm. long, scarious, caducous; calyx-lobes broadly ovate to ovate-oblong, obtuse or rounded, unequal, 0.55–0.8 cm. long, scarious, densely puberulent-papillate without, the internal squamellae in alternate groups of 2–6; corolla infundibuliform, densely velutinous-papillate without, the proper-tube 1.2–2.0 cm. long, about 0.35 cm. in diameter at the base, the throat narrowly conical to conical-campanulate, 2–3 cm. long, 0.5–1.0 cm. in diameter at the orifice, the lobes broadly dolabriform, obtuse or rounded, 1.5–1.8 cm. long, widely spreading; stamens inserted in the corolla-tube proper below the dilation of the throat, the anthers narrowly elliptic to linear, 0.4–0.6 cm. long, papillate dorsally; ovary broadly

ovoid, 0.1–0.15 cm. long, minutely velutinous to glabrate; stigma fusiform, usually broadly 2-lobed, 0.2–0.3 cm. long; nectaries concrescent, entire or more or less undulate or crenulate, ½ to ⅔ as long as the ovary; mature follicles unknown.

PANAMA: COLON: high hills back of Puerto Obaldia, San Blas Coast, alt. 50–200 m., Aug., 1911, *Pittier 4329* (B, S, US).

BRAZIL: PARA: Belem do Para, silva secundaria, loco humido, Febr. 1, 1928, *Ducke 21585* (B); Santa Izabel, ad viam ferream, Belem-Bragança, silva paludosa, Sept. 22, 1908, *Ducke 21624* (B); vicinity of Para, Dec. 28, 1907, *Baker 84* (D); AMAZONAS: in sylvis Japurensibus, Jan., year lacking, *Martius s.n.* (M, TYPE, MBG, photograph and analytical drawings); campo, Fortaleza, Oct., 1901, *Ule 5923* (B).

PERU: LORETO: Flutfreier Hochwald, Mündung de Santiago, alt. 160 m., Sept. 11, 1924, *Tessmann 4009* (B, D, S); same locality, Oct. 21, 1924, *Tessmann 4356* (B, D); lower Rio Huallaga, alt. 155–210 m., Oct.–Nov., 1929, *Williams 4024* (B, FM); forest, Mishuyacu, near Iquitos, alt. 100 m., Oct.–Nov., 1929, *Klug 422* (FM); same locality, Dec., 1929, *Klug 657* (FM, US).

The rather disintegrated geographical distribution of this species has not been clarified by the discovery of morphological characters which might be used for taxonomic subdivision. In the variability of leaf outline and dimensions of the corolla *O. cognata* vividly recalls *O. Hoffmannseggiana*, which has a very similar distribution.

2. **Odontadenia funigera** Woodson, spec. nov.

Suffruticosa volubilis altitudine ignota; ramulis teretibus crassiusculis cortice rubro-brunneis conspicue lenticellatis; foliis oppositis petiolatis late ovalibus apice abrupte acutis basi obtusis 6–25 cm. longis 4.5–12.0 cm. latis utrinque opacis; petiolis 1–2 cm. longis; stipulis ovatis acutis 0.2–0.4 cm. longis scariaceis caducis; inflorescentiis corymboso-thyrsiformibus terminalibus lateralibusque 6–20-floris pedunculo petiolos ca. bis terve superante; pedicellis 1.3–1.5 cm. longis post maturitatem paulo accrescentibus minute denseque papillatis; bracteis ovatis 0.2–0.3 cm. longis scariaceis caducis; calycis laciniis ovato-oblongis obtusis rotundatisve inaequalibus 0.6–0.8 cm. longis scariaceis extus minute papillatis intus cum sequentibus alternatis 2–4-glanduligeris; corollae infundibuliformis fulgide flavae extus omnino glabrae tubo proprio 1.5–1.7 cm. longo basi ca. 0.25 cm. diametro metiente faucibus anguste campanu-

latis vel late tubulosis abrupte dilatatis plus minusve ventricosis 2.7–3.0 cm. longis ostio ca. 1.5 cm. diametro metiente lobis oblique obovatis obtusis rotundatisve ca. 3 cm. longis patulis; staminibus sub dilatatione faucium insertis antheris linearibus anguste auriculatis 0.6 cm. longis dorso minute papillatis; ovario latissime ovoideo ca. 0.15 cm. alto minute puberulo-papillato; stigmate fusiformi ca. 0.3 cm. longo; nectariis concrescentibus subintegris ovario ca. bis brevioribus; folliculis ignotis.

Stems relatively stout, dull reddish-brown, glabrous, conspicuously lenticellate when fully mature; leaves opposite, petiolate, broadly oval, apex abruptly acute, base obtuse, 6–25 cm. long, 4.5–12.0 cm. broad, either surface opaque; petioles 1–2 cm. long; stipules 2, ovate, acute, 0.2–0.4 cm. long, scarious, caducous; inflorescence corymbose-thyrsiform, terminal and lateral, bearing 6–20 bright yellow flowers; peduncle about 2–3 times longer than the subtending petioles; pedicels 1.3–1.5 cm. long, slightly accrescent after maturity, minutely and densely papillate; bracts ovate, 0.2–0.3 cm. long, scarious, caducous; calyx-lobes ovate-oblong, obtuse or rounded, unequal, 0.6–0.8 cm. long, scarious, without minutely papillate, the internal squamellae in alternate groups of 2–4; corolla infundibuliform, glabrous without, the proper-tube 1.5–1.7 cm. long, about 0.25 cm. in diameter at the base, the throat narrowly campanulate or broadly tubular, abruptly dilated, more or less ventricose, 2.7–3.0 cm. long, about 1.5 cm. in diameter at the orifice, the lobes obliquely obovate, obtuse or rounded, about 3 cm. long, widely spreading; stamens inserted below the dilation of the corolla-throat, the anthers linear, narrowly auriculate, 0.6 cm. long, minutely papillate dorsally; ovary broadly ovoid, about 0.15 cm. long, minutely puberulent-papillate; stigma fusiform, about 0.3 cm. long; nectaries concrescent, subentire, about ½ as long as the ovary; follicles unknown.

BRAZIL: AMAZONAS: sandy woods, Manãos, alt. 25 m., Oct. 13, 1929, *Killip & Smith 30048* (MBG, TYPE, US).

The relationships of this species, previously confused with *O. cognata,* are set forth in the key to species.

3. **Odontadenia surinamensis** Woodson, spec. nov.

Suffruticosa volubilis omnino glabra altitudine ignota; ramulis teretibus gracilibus cortice rubro-brunneis conspicue lenticellatis; foliis oppositis breviter petiolatis ovalibus apice acutis vel brevissime acuminatis basi obtusis 12–15 cm. longis 5–7 cm. latis utrinque opacis; petiolis 1.0–1.5 cm. longis; stipulis haud visis; inflorescentiis corymboso-thyrsiformibus terminalibus ca. 20–40-floris pedunculo petiolos subaequante; pedicellis 0.8–1.0 cm. longis post maturitatem paulo accrescentibus; bracteis ovato-lanceolatis acuminatis 0.2–0.4 cm. longis scariaceis caducis; calycis laciniis oblongis obtusis rotundatisve inaequalibus 0.6–0.7 cm. longis extus minute papillatis intus cum sequentibus alternatis 2–4-glanduligeris; corollae infundibuliformis viridi- vel flavidulo-albidae extus glabrae vel indistincte papillatae tubo proprio 1.0–1.3 cm. longo basi ca. 0.1 cm. diametro metiente faucibus angustissime conicis 2.6–3.0 cm. longis ostio ca. 0.3–0.4 cm. diametro metiente lobis late dolabriformibus obtusis 0.7–0.9 cm. longis patulis; staminibus sub dilatatione faucium insertis antheris anguste elliptico-oblongis acuminatis anguste auriculatis 0.45 cm. longis dorso minute papillatis; ovario late ovoideo ca. 0.15 cm. longo glabro; stigmate fusiformi apice obtuse 2-lobato 0.2 cm. longo; nectariis concrescentibus subintegris ovario ca. bis brevioribus; folliculis ignotis.

Plants glabrous; stems relatively slender, dull reddish-brown, conspicuously lenticellate when fully mature; leaves opposite, shortly petiolate, oval, apex acute to very shortly acuminate, base obtuse, 12–15 cm. long, 5–7 cm. broad, either surface opaque; petioles 1.0–1.5 cm. long; stipules caducous, not seen; inflorescence corymbose-thyrsiform, terminal, bearing about 20–40 greenish- or yellowish-white flowers; peduncle about as long as the subtending petioles; pedicels 0.8–1.0 cm. long, somewhat accrescent after maturity; bracts ovate-lanceolate, acuminate, 0.2–0.4 cm. long, scarious, caducous; calyx-lobes oblong, obtuse or rounded, unequal, 0.6–0.7 cm. long, minutely papillate without, the internal squamellae in alternate groups of 2–4; corolla infundibuliform, glabrous or indistinctly papillate without, the proper-tube 1.0–1.3 cm. long,

about 0.1 cm. in diameter at the base, the throat very narrowly conical, 2.6–3.0 cm. long, about 0.3–0.4 cm. in diameter at the orifice, the lobes broadly dolabriform, 0.7–0.9 cm. long, widely spreading; stamens inserted below the dilation of the corolla-throat, the anthers narrowly elliptic-oblong, acuminate, narrowly auriculate, 0.45 cm. long, minutely papillate dorsally; ovary broadly ovoid, about 0.15 cm. long, glabrous; stigma fusiform, bluntly 2-lobed, 0.2 cm. long; nectaries concrescent, nearly entire, about half as tall as the ovary; follicles unknown.

DUTCH GUIANA: fluv. Tapanahoni, July, 1904, *Versteeg 680* (U, TYPE, MBG, photograph and analytical drawings).

Differs from *O. cognata* chiefly in the much shorter inflorescence, narrower, glabrous corolla, and narrower calyx-lobes, as set forth in the key to species. This species has previously been confused with *O. puncticulosa.*

4. **Odontadenia neglecta** Woodson, spec. nov.

Suffruticosa volubilis; ramulis teretibus crassiusculis cortice rubro-brunneis conspicue lenticellatis glabris; foliis oppositis breviter petiolatis ovato-ellipticis apici acutis basi obtusis subrotundatisve 6–10 cm. longis 2.5–6.0 cm. latis firme membranaceis omnino glaberrimis opacis subtus nervo medio venisque conspicuis subverrucosis; petiolis 0.7–0.9 cm. longis; stipulis interpetiolaribus 2 late oblongo-lanceolatis scariaceis caducis; inflorescentiis thyrsiformibus plurifloris et terminalibus et lateralibus folia superantibus; pedicellis 0.5–0.7 cm. longis post maturitatem paulo accrescentibus glabris; bracteis oblongo-lanceolatis 0.1–0.3 cm. longis scariaceis caducis; calycis laciniis conspicue inaequalibus oblongo-ovatis rotundatis arcte imbricatis exterioribus 0.5–0.6 cm. longis interioribus 0.7–0.9 cm. longis scariaceis extus glabris vel marginibus minute ciliolatis intus basi in marginibus 2-glanduligeris; corollae infundibuliformis luteae extus omnino glabrae tubo proprio gracile cylindrico 1.0–1.2 cm. longo basi ca. 0.15 cm. diametro metiente faucibus gradatim dilatatis anguste cylindrico-conicis 1.9–2.1 cm. longis ostio ca. 0.7 cm. diametro metiente lobis oblique obovatis brevissime acuminatis 1.8–2.0 cm. longis patulis; staminibus sub dilatatione faucium insertis antheris oblongo-

linearibus anguste 2-auriculatis acuminatis 0.5 cm. longis apice minutissime papillatis caeterum glabris; ovario late ovoideo minute papillato ca. 0.1 cm. longo; stigmate anguste fusiforme 0.2 cm. longo; nectario alte annulato subintegro ovarium subaequante; folliculis ignotis.

Stems relatively stout, glabrous, reddish-brown, conspicuously lenticellate when fully mature; leaves opposite, shortly petiolate, ovate-elliptic, apex acute, base obtuse to rounded, 6–10 cm. long, 2.5–6.0 cm. broad, firmly membranaceous, glabrous, opaque, the midrib and veins conspicuously subverrucose beneath; petioles 0.7–0.9 cm. long; stipules 2, interpetiolar, broadly oblong-lanceolate, scarious, caducous; inflorescence thyrsiform, several-flowered, both terminal and lateral, somewhat surpassing the subtending leaves; pedicels 0.5–0.7 cm. long, somewhat accrescent at maturity, glabrous; bracts oblong-lanceolate, 0.1–0.3 cm. long, scarious, caducous; calyx-lobes conspicuously unequal, oblong-ovate, rounded, closely imbricated, the outer 0.5–0.6 cm. long, the inner 0.7–0.9 cm. long, scarious, glabrous without, or the margins minutely ciliolate, the internal squamellae in alternate pairs; corolla infundibuliform, glabrous without, the proper-tube 1.0–1.2 cm. long, about 0.15 cm. in diameter at the base, the throat narrowly cylindrical-conical, 1.9–2.1 cm. long, about 0.7 cm. in diameter at the orifice, the lobes obliquely obovate, very shortly acuminate, 1.8–2.0 cm. long, spreading; stamens inserted somewhat below the dilation of the corolla-throat, the anthers oblong-linear, narrowly 2-auriculate, 0.5 cm. long, very minutely papillate toward the tips, otherwise glabrous; ovary broadly ovoid, minutely papillate, about 0.1 cm. long; stigma narrowly fusiform, 0.2 cm. long; nectary annular, subentire, about equalling the ovary; follicles unknown.

Brazil: amazonas: prope Panure ad Rio Uaupes, Oct. 1852–Jan. 1853, *Spruce 2748* (K, type, MBG, photograph and analytical drawings).

5. **Odontadenia verrucosa** (R. & S.) K. Sch. ex Mgf. in Pulle, Fl. Surinam **4:** 53. 1932.

Echites verrucosa R. & S. Syst. **4:** 795. 1819; A. DC. in DC. Prodr. **8:** 475. 1844.

Echites amazonica Stadelm. Flora **24**[1]: Beibl. 50. 1841; A. DC. loc. cit. 464. 1844.

Anisolobus amazonicus (Stadelm.) Muell.-Arg. in Mart. Fl. Bras. **6**[1]: 114. 1860.

Echites bicornis R. Spruce, ex Muell.-Arg. loc. cit. 1860, nom. nud. in synon.

Anisolobus amazonicus (Stadelm.) Muell.-Arg. β. *latifolius* Muell.-Arg. loc. cit. 1860.

Anisolobus Sprucei Muell.-Arg. loc. cit. 1860.

Angadenia Amazonica (Stadelm.) Miers, Apoc. So. Am. 175. 1878.

Angadenia latifolia (Muell.-Arg.) Miers, loc. cit. 176. 1878.

Angadenia Sprucei (Muell.-Arg.) Miers, loc. cit. 1878.

Odontadenia Sprucei (Muell.-Arg.) K. Sch. in Engl. & Prantl, Nat. Pflanzenfam. **4**[2]: 169. 1895.

Odontadenia amazonica (Stadelm.) Malme, Arkiv f. Bot. **21A**[6]: 17. 1927.

Stems relatively stout, minutely puberulent when very young, glabrate and conspicuously lenticellate when fully mature; leaves opposite, petiolate, rather narrowly obovate-elliptic, apex shortly and obtusely acuminate, base acute, somewhat cuneate, 9–16 cm. long, 3.5–6.5 cm. broad, subcoriaceous, either surface glabrous, opaque, the lower somewhat paler; petioles 0.7–1.0 cm. long; stipules 2, broadly dentiform, about 0.1 cm. long, scarious, caducous; inflorescence thyrsiform, terminal, densely canescent, somewhat shorter than the subtending leaves, bearing 12–30 greenish, cream-colored flowers; pedicels 1.0–1.7 cm. long, somewhat accrescent after maturity; bracts minutely ovate, 0.1–0.2 cm. long, scarious, caducous; calyx-lobes ovate to broadly ovate-oblong, obtuse or rounded, unequal, 0.3–0.5 cm. long, scarious, minutely and densely papillate without, the internal squamellae in alternate groups of 2–3; corolla infundibuliform, densely and minutely velutinous-papillate without, the proper-tube 0.8–1.0 cm. long, about 0.2 cm. in diameter at the base, the throat narrowly tubular-conical, 1.5–2.3 cm. long, about 0.5 cm. in diameter at the orifice, the lobes obliquely obovate-oblong, obscurely acuminate, 0.9–

1.5 cm. long, widely spreading; stamens inserted just below the dilation of the corolla-throat, the anthers elliptic-linear, narrowly auriculate, 0.4–0.6 cm. long, minutely hirtellous dorsally; ovary oblongoid, about 0.15 cm. long, densely puberulent-papillate; stigma fusiform-capitate, with 5 inconspicuous basal projections, 0.2 cm. long; nectaries concrescent, subentire or minutely crenulate, about as long as the ovary; follicles relatively stout, divaricate, 12–15 cm. long, densely canescent without; seeds about 1 cm. long, the pale tawny coma about 2 cm. long.

Brazil: para: insulae Brenes aestuarii amazonici, Sept. 6, 1901, *Guedes 21800* (B); in ripa Ygarape et Tagipuru, Aug., year lacking, *Martius 2663* (M, MBG, photograph and analytical drawings); amazonas: prope Panure ad Rio Uaupes, Oct., 1852–Jan., 1853, *Spruce 2503* (B, Bx, Camb., D); ad flum. Guiania v. Rio Negro supra ostium fluminis Casiquiari, 1854, *Spruce 3550* (Bx, Camb., V, MBG, photograph and analytical drawings); Panure ad Rio Uaupes, Oct., 1852–Jan., 1853, *Spruce 2555* (C, Camb., G, MBG, photograph and analytical drawings).

Spruce 2555 and *Spruce 2503*, referred to *Anisolobus Sprucei* and *A. amazonicus* respectively by Mueller-Argoviensis, are virtually indistinguishable except for the very slightly more copious indument of the former. The collector's data do not contradict the assumption that both were from the same locality, if not from the same plant or colony.

6. **Odontadenia affinis** Woodson, Ann. Mo. Bot. Gard. **18**: 549. 1931.

Stems relatively slender, glabrous, reddish-brown, rather inconspicuously lenticellate when fully mature; leaves opposite, shortly petiolate, oblong-ovate, apex shortly and obtusely subcuspidate-acuminate, base acutish, 6–8 cm. long, 3.5–4.0 cm. broad, subcoriaceous, glabrous, opaque; petioles 0.5–0.8 cm. long; inflorescence lateral, thyrsiform, relatively few-flowered, somewhat shorter than the subtending leaves; bracts very inconspicuous; pedicels about 0.5 cm. long, glabrous; calyx-lobes ovate, obtusish, more or less conspicuously unequal, 0.4–0.55 cm. long, glabrous, or the margins very minutely ciliolate, the squamellae in alternate groups of 3–4; corolla infundibuliform, glabrous without, the proper tube 1.5–1.7 cm. long, about

0.25 cm. in diameter at the base, the throat conical, 2.0–2.3 cm. long, about 0.55 cm. in diameter at the orifice, the lobes obliquely obovate, 1.5–2.0 cm. long, spreading; stamens inserted somewhat below the dilation of the corolla-throat, the anthers narrowly lanceolate-sagittate, 0.5 cm. long, very minutely papillate dorsally; ovary broadly ovoid, about 0.15 cm. long, glabrous; stigma fusiform, about 0.2 cm. long; nectary annular, crenulate, much shorter than the ovary; follicles unknown.

PERU: LORETO: dense forest, Balsapuerto, alt. 150–350 m., Aug. 28–30, 1929, *Killip & Smith 28609* (US, TYPE, MBG, photograph and analytical drawings).

7. Odontadenia Killipii Woodson, Ann. Mo. Bot. Gard. **18**: 546. 1931.

Stems relatively stout, glabrous, conspicuously lenticellate when fully mature; leaves opposite, petiolate, broadly elliptic-oblong, apex abruptly and obtusely acuminate, base obtuse to acutish, 6–8 cm. long, 3–5 cm. broad, subcoriaceous, glabrous; petioles 1.0–1.5 cm. long, glabrous; inflorescence terminal, thyrsiform, somewhat surpassing the subtending leaves, bearing 15–20 showy, yellowish flowers, glabrous throughout; pedicels 0.5–0.7 cm. long; bracts ovate, 0.2–0.3 cm. long, scarious; calyx-lobes conspicuously unequal, ovate to ovate-oblong, obtuse, 0.2–0.3 cm. long, glabrous or essentially so, the internal squamellae solitary or in alternate pairs; corolla infundibuliform, glabrous without, the proper tube 1.0–1.5 cm. long, about 0.2 cm. in diameter at the base, the throat conical, 2.0–2.5 cm. long, about 1 cm. in diameter at the orifice, the lobes obliquely obovate-dolabriform, 2.5–3.0 cm. long, spreading; stamens inserted somewhat below the dilation of the corolla-throat, the anthers linear-sagittate, 0.3–0.4 cm. long, minutely puberulent-papillate dorsally; ovary ovoid-oblongoid, about 0.15 cm. long, glabrous; stigma fusiform, 0.2 cm. long; nectary tubular, entire or minutely crenulate, somewhat surpassing the ovary; follicles unknown.

PERU: LORETO: woods, Iquitos, alt. about 100 m., Sept. 26, 1929, *Killip & Smith 29847* (MBG, TYPE, US); Flussfreier Urwald, Iquitos, alt. 100 m., May 9, 1925, *Tessmann 5100* (B).

8. Odontadenia cordigera Woodson, spec. nov.

Suffruticosa volubilis omnino glaberrima altitudine ignota; ramulis crassiusculis maturitate cortice rubro-brunneis dense lenticellatis; foliis oppositis breviter petiolatis obovatis apice rotundatis non rarius sensim emarginatis basi obscure cordatis 7–8 cm. longis 4–6 cm. latis utrinque opacis; petiolis 0.5–0.7 cm. longis; stipulis 2 late reniformibus 0.2–0.3 cm. longis scariaceis caducis; inflorescentiis corymboso-thyrsiformibus lateralibus ca. 15–30-floris folia subaequantibus; pedicellis 0.4–0.5 cm. longis, post maturitatem paulo accrescentibus; bracteis minute ovatis ca. 0.1 cm. longis scariaceis caducis; calycis laciniis ovatis vel late trigonalibus obtusis rotundatisve inaequalibus 0.3–0.4 cm. longis scariaceis extus glabris intus basi cum sequentibus alternatis 1–2-glanduligeris; corollae infundibuliformis fulgide flavae extus glabrae tubo proprio 0.9–1.1 cm. longo basi ca. 0.15 cm. diametro metiente faucibus anguste conicis 2.0–2.3 cm. longis ostio ca. 1.2 cm. diametro metiente lobis oblique obovatis ca. 1.7 cm. longis patulis; staminibus sub dilatatione faucium insertis antheris linearibus acuminatis anguste auriculatis ca. 0.4 cm. longis dorso indistincte papillatis; ovario oblongoideo ca. 0.1 cm. longo glabro; stigmate fusiformi ca. 0.2 cm. longo; nectariis imperfecte concrescentibus manifeste inaequalibus tenuibus ovario multo brevioribus; folliculis desiderantibus.

Plants completely glabrous; stems relatively stout, reddish-brown, densely lenticellate when fully mature; leaves opposite, shortly petiolate, obovate, apex rounded, not infrequently somewhat emarginate, base obscurely cordate, 7–8 cm. long, 4–6 cm. broad, either surface opaque; petioles 0.5–0.7 cm. long; stipules 2, broadly reniform, 0.2–0.3 cm. long, scarious, caducous; inflorescence corymbose-thyrsiform, lateral, about equalling the subtending leaves, bearing 15–30 bright yellow flowers; pedicels 0.4–0.5 cm. long, somewhat accrescent at maturity; bracts minutely ovate, about 0.1 cm. long, scarious, caducous; calyx-lobes ovate or broadly trigonal, obtuse or rounded, unequal, 0.3–0.4 cm. long, scarious, glabrous without, the internal alternate squamellae solitary or paired; corolla infundibuliform, glabrous without, the proper-tube 0.9–1.1 cm. long, about 0.15

cm. in diameter at the base, the throat narrowly conical, 2.0–2.3 cm. long, about 1.2 cm. in diameter at the orifice, the lobes broadly obovate, about 1.7 cm. long, widely spreading; stamens inserted somewhat below the dilation of the corolla-throat, the anthers linear, acuminate, narrowly auriculate, about 0.4 cm. long, indistinctly papillate dorsally; ovary oblongoid, about 0.1 cm. long, glabrous; stigma fusiform, about 0.2 cm. long; nectaries imperfectly concrescent, manifestly unequal, tenuous, much shorter than the ovary; follicles unknown.

PERU: LORETO: dense forest, Mishuyacu, near Iquitos, alt. about 100 m., Sept. 24–28, 1929, *Killip & Smith 29916* (MBG, TYPE, US).

9. **Odontadenia lutea** (Vell.) Mgf. in Fedde, Rep. Sp. Nov. **20**: 24. 1924.

Echites lutea Vell. Fl. Flum. 109. 1830; Icon. **3**: *pl. 25.* 1827; A. DC. in DC. Prodr. **8**: 467. 1844; Muell.-Arg. in Mart. Fl. Bras. **6**[1]: 159. 1860; Miers, Apoc. So. Am. 194. 1878.

Echites Zuccariniana Stadelm. Flora **24**[1]: Beibl. 76. 1841; A. DC. loc. cit. 471. 1844.

Anisolobus hebecarpus Muell.-Arg. loc. cit. 111. *pl. 33.* 1860; Miers, loc. cit. 170. 1878.

Anisolobus hebecarpus Muell.-Arg. α. *tomentosus* Muell.-Arg. loc. cit. 112. 1860.

Anisolobus hebecarpus Muell.-Arg. α. *tomentosus* Muell.-Arg. *a. erectus* Muell.-Arg. loc. cit. 1860.

Anisolobus hebecarpus Muell.-Arg. α. *tomentosus* Muell.-Arg. *b. scandens* Muell.-Arg. loc. cit. 1860.

Anisolobus hebecarpus Muell.-Arg. β. *glabratus* Muell.-Arg. loc. cit. 1860.

Echites pulcherrima Pohl, ex Muell.-Arg. loc. cit. 1860, nom. nud. in synon.

Echites hebecarpa Benth. ex Muell.-Arg. loc. cit. 1860, nom. nud. in synon.

Anisolobus Zuccarinianus (Stadelm.) Miers, loc. cit. 171. 1878.

Anisolobus pulcherrimus Miers, loc. cit. 1878.

Odontadenia Zuccariniana (Stadelm.) K. Sch. in Engl. & Prantl, Nat. Pflanzenfam. **4**^{2}: 169. 1895.

Odontadenia Zuccariniana (Stadelm.) K. Sch. f. *angustifolia* Malme, Bihang till K. Sv. Vet. Akad. Handl. Afd. III. **24**^{10}: 23. 1899.

Odontadenia Zuccariniana (Stadelm.) K. Sch. f. *ovalifolia* Malme, loc. cit. 1899.

Odontadenia Zuccariniana (Stadelm.) K. Sch. var. *tomentosa* Muell.-Arg. f. *scandens* Muell.-Arg. ex Mgf. Notizblatt **9**: 80. 1924, sphalm.

Plants densely and minutely hirtellous to glabrate or glabrous; stems relatively stout, becoming conspicuously lenticellate when fully mature; leaves opposite, the blade subcoriaceous, broadly oval to narrowly oblong-elliptic, apex obtuse or rounded to broadly acuminate, base narrowly and rather obscurely cordate, 7–15 cm. long, 3–6 cm. broad, drying dark brownish-green, either surface opaque, the lower somewhat paler, the petiole 0.5–0.75 cm. long; stipules 2, oblong, 0.5–0.75 cm. long, caducous; inflorescence lateral to subterminal, contracted-thyrsiform, many-flowered, usually somewhat surpassed by the subtending leaves, densely canescent to glabrate; pedicels 1.5–2.0 cm. long, somewhat accrescent at maturity, the subtending bracts ovate-lanceolate, 0.4–0.6 cm. long, caducous; calyx-lobes conspicuously unequal, ovate to broadly oblong, broadly obtuse or rounded, 0.75–1.25 cm. long, the squamellae solitary or rarely geminate, narrowly liguliform; corolla infundibuliform, whitish tinged with yellow, glabrous without, the proper-tube cylindrical, somewhat inflated at the base, contracting toward the insertion of the stamens, 1.75–2.0 cm. long, about 0.4 cm. in diameter at the base, the throat broadly conical-campanulate, 2.0–2.25 cm. long, about 1.25 cm. in diameter at the orifice, the lobes obliquely obovate, shortly acuminate, 2.25–3.0 cm. long, widely spreading; stamens inserted at the base of the corolla-throat, the anthers narrowly elliptic-sagittate, 0.8 cm. long, minutely hirtellous dorsally; carpels oblong-ovoid, 0.2 cm. long, minutely papillate; stigma fusiform-capitate, with 5 obscure basal lobes, 0.2 cm. long; nectary annular, deeply 5-lobed,

about twice surpassing the ovary; follicles relatively stout, divaricate, 15–20 cm. long, glabrous to minutely velutinous (according to Muell.-Arg.); seeds unknown.

BRAZIL: PARA: in vicinibus Santarem, June, 1850, *Spruce s.n.* (C, Camb., V, MBG, photograph); RIO DE JANEIRO: environs de Rio de Janeiro, Febr., 1882, *Glaziou 12957* (C, K): MINAS GERAES: Trahiras, date lacking, *Pohl 1899* (V); Corallino, date lacking, *Pohl 1383* (V); SÃO PAULO: inter Canna Verde et S. João, Febr., 1849, *Regnell III 880* (S); Batataes, Febr., 1849, *Regnell III 850* (S); MATTO GROSSO: Serra do Itapirapuan, in campo dumetoso ("cerrado"), April 29, 1894, *Lindmann A3337* (S); Cuyaba, in "cerrado," April 10, 1894, *Malme 1536* (S); Sta. Anna da Chapada, in "cerrado," July 29, 1902, *Malme s.n.* (S).

Odontadenia lutea is extremely variable in leaf size and outline, and particularly so in indument. Mueller recognized several subspecific categories in dealing with this species, and justification may exist for such a treatment. Nevertheless, the numerous specimens examined during the course of this study have revealed such a complicated range of intergradations that it has been resolved to postpone subspecific division until the genus can be studied more intimately, preferably by a student resident in the South American tropics.

10. **Odontadenia puncticulosa** (A. Rich.) Pulle, Enum. Pl. Surinam 383. 1906.[1]

Echites puncticulosa A. Rich. Act. Soc. Hist. Nat. Paris **1**: 107. 1792; E. Mey. Nov. Act. Acad. Nat. Cur. **12**: 782. 1824.

Echites Cururu Mart. in Buchn. Rep. Pharm. 101. 1830; Stadelm. Flora **24**[1]: Beibl. 78. 1841; A. DC. in DC. Prodr. **8**: 470. 1844.

Echites Cururu Mart. var. α. *angustifolia* Stadelm. loc. cit. 1841.

Echites Cururu Mart. var. β. *grandifolia* Stadelm. loc. cit. 79. 1841; A. DC. loc. cit. 1844.

Anisolobus Kappleri Miq. Linnaea **18**: 737. 1844.

[1] Originally published by Pulle citing E. Mey. parenthetically. Meyer, however, in the work cited above, gives Richard as authority for *E. puncticulosa*, and his extended description should be construed, therefore, as supplementing the meagre diagnosis of the earlier author.

Anisolobus puncticulosus (A. Rich.) Miq. Stirp. Surinam. 158. 1851; Miers, Apoc. So. Am. 172. 1878.

Anisolobus Fockei Miq. loc. cit. 159. 1851; Miers, loc. cit. 1878.

Anisolobus Hostmanni Miq. loc. cit. 1851; Miers, loc. cit. 1878.

Anisolobus Cururu (Mart.) Muell.-Arg. in Mart. Fl. Bras. **6**[1]: 112. *pl. 34.* 1860.

Anisolobus Cururu (Mart.) Muell.-Arg. β. *grandifolius* (Stadelm.) Muell.-Arg. loc. cit. 113. 1860.

Angadenia Cururu (Mart.) Miers, loc. cit. 175. 1878.

Angadenia grandifolia (Stadelm.) Miers, loc. cit. 1878.

Odontadenia Cururu (Mart.) K. Sch. in Engl. & Prantl, Nat. Pflanzenfam. **4**[2]: 169. 1895.

Stems relatively stout, glabrous or minutely puberulent when young, conspicuously lenticellate when fully mature; leaves opposite, the blade subcoriaceous, ovate- to oblong-elliptic, apex shortly and obtusely acuminate, base obtuse to broadly acute, 8–20 cm. long, 3.5–10.0 cm. broad, either surface opaque, glabrous, drying dark brown, the lower somewhat paler, the petiole 0.5–1.0 cm. long; stipules 2, broadly ovate, 0.2–0.3 cm. long, caducous; inflorescence terminal, thyrsiform, many-flowered, somewhat surpassing the subtending leaves, minutely canescent; pedicels 0.75–1.0 cm. long, somewhat accrescent at maturity, the subtending bracts minutely ovate-reniform; calyx-lobes conspicuously unequal, ovate to broadly ovate-oblong, obtuse or rounded, 0.3–0.5 cm. long, the squamellae geminate; corolla infundibuliform, minutely papillate to glabrate without, the proper-tube cylindrical, slightly gibbous-inflated toward the base, sharply constricted toward the insertion of the stamens, 1.0–1.5 cm. long, about 0.3 cm. in diameter at the base, the throat narrowly tubular-conical, 2.0–2.75 cm. long, 0.6–0.75 cm. in diameter at the orifice, the lobes obliquely obovate-oblong, rather obscurely acuminate, 1.75–2.25 cm. long, widely spreading; stamens inserted at the base of the corolla-throat, the anthers narrowly oblong-elliptic, 0.5–0.6 cm. long, densely hirtellous dorsally; ovary oblongoid, 0.2 cm. long, glabrous; stigma obtusely fusiform with 5 inconspicuous, acute,

basal projections, 0.2 cm. long; nectary tubular, completely concealing the ovary; follicles unknown.

DUTCH GUIANA: e regione Surinam. super., date lacking, *Wullschlägel 321* (V); in virgultis, date lacking, *Hostmann & Kappler 1203* (Camb., MBG, S); data incomplete, *Hostmann 629* (S).

BRAZIL: AMAZONAS: Vista Alegre, Rio Branco, Jan. 9, 1924, *Kuhlmann 21858* (S); Ega, date lacking, *Poeppig 2657* (V); PARA: Santa Izabel, ad viam ferream Belem-Bragança, Oct., 1906, *Goeldi 21777* (S).

11. Odontadenia spoliata Malme, Arkiv f. Bot. **21A**[6]: 16. 1927.

Stems relatively stout, dull reddish-brown, minutely puberulent-papillate when very young, glabrate and conspicuously lenticellate when fully mature; leaves opposite, shortly petiolate, broadly ovate-elliptic, apex acute, base broadly obtuse or rounded, 11–14 cm. long, 6–9 cm. broad, firmly membranaceous to chartaceous, either surface opaque, the upper glabrous, the lower minutely tomentulose; petioles 1.0–1.5 cm. long; stipules 2, ovate-oblong, acute, 0.3–0.4 cm. long, scarious, caducous; inflorescence thyrsiform, terminal, somewhat shorter than the subtending leaves, bearing 6–12 cream-colored flowers; peduncle about twice as long as the petioles, densely canescent; pedicels 1.5–1.7 cm. long, somewhat accrescent after maturity, densely and minutely canescent; bracts ovate-lanceolate, 0.2–0.4 cm. long, scarious, caducous; calyx-lobes ovate, obtuse, unequal, 0.45–0.5 cm. long, scarious, papillate without, the internal squamellae in alternate groups of 3–6; corolla infundibuliform, minutely velutinous-papillate without, the proper-tube 1.3–1.6 cm. long, about 0.5 cm. in diameter at the base, the throat broadly tubular, 2.7–3.3 cm. long, about 1 cm. in diameter at the orifice, the lobes obliquely obovate, obtuse or rounded, 1.3–1.6 cm. long, widely spreading; stamens inserted at the base of the corolla-throat, the anthers narrowly oblong-elliptic, acuminate, narrowly auriculate, about 0.6 cm. long, minutely papillate dorsally; ovary ovoid, about 0.5 cm. long, glabrous or indistinctly puberulent-papillate; nectaries concrescent, irregularly erose, somewhat surpassing the ovary; follicles unknown.

BRAZIL: MATTO GROSSO: in silva ripa rivi, Sta. Anna da Chapada, July 20, 1902, *Malme 2036* (S, TYPE, MBG, photograph and analytical drawings).

The unusual foliar indument appears to be the chief mark of distinction between this species and *O. puncticulosa,* of which it might better be interpreted as a variety.

12. **Odontadenia Perrottetii** (A. DC.) Woodson, Ann. Mo. Bot. Gard. **18**: 546. 1931.

Anisolobus Perrottetii A. DC. in DC. Prodr. **8**: 395. 1844; Muell.-Arg. in Mart. Fl. Bras. **6**^{1}: 115. 1860; Miers, Apoc. So. Am. 169. 1878.

Anisolobus Perrottetii A. DC. β. *obtusus* Muell.-Arg. loc. cit. 1860.

Stems relatively stout, dull yellowish-brown, glabrous, conspicuously lenticellate when fully mature; leaves opposite, petiolate, broadly oval to oblong-elliptic, apex rather abruptly acuminate, base broadly obtuse or rounded, 7–13 cm. long, 2–6 cm. broad, subcoriaceous, either surface glabrous, opaque, or the upper somewhat nitidulous; petioles 0.8–1.5 cm. long; stipules ovate-trigonal, acute, 0.3–0.5 cm. long, scarious, caducous; inflorescence corymbose-thyrsiform, both terminal and lateral, bearing 2–10 pale yellowish flowers; peduncle glabrous, somewhat less than half as long as the subtending leaves; pedicels 1.0–1.5 cm. long, glabrous; bracts ovate, 0.2–0.3 cm. long, scarious, caducous; calyx-lobes ovate to ovate-oblong, broadly obtuse to rounded, 0.8–1.2 cm. long, scarious, glabrous without, the internal squamellae in alternate groups of 4–6; corolla infundibuliform, glabrous without, the proper-tube 0.9–1.5 cm. long, about 0.3 cm. in diameter at the base, the throat tubular-conical, 2.0–2.2 cm. long, about 0.6 cm. in diameter at the orifice, the lobes obliquely obovate, rounded, 1.2–1.5 cm. long, widely spreading; stamens inserted at the base of the corolla-throat, the anthers narrowly oblong, acuminate, narrowly and sharply auriculate, 0.6 cm. long, finely papillate dorsally; ovary ovoid, about 0.15 cm. long, glabrous; stigma fusiform, about 0.2 cm. long; nectaries concrescent, irregularly lacerate, concealing the ovary, about 0.2 cm. long; immature follicles relatively stout, divaricate, minutely puberulent-papillate.

FRENCH GUIANA: exact locality lacking, 1821, *Perrottet 270* (DC, TYPE).

BRAZIL: PARA: campos do Ariramba, regione fl. Trombetas, Oct. 9, 1913, *Ducke*

216647 (B); MARANHÃO: exact locality and date lacking, *Martius s.n.* (Bx); MATTO GROSSO: Chiquitos, 1842, *d'Orbigny 879* (Bx, D).

13. **Odontadenia Sandwithiana** Woodson, Ann. Mo. Bot. Gard. **18**: 547. 1931.

Plants completely glabrous; stems terete, relatively slender, dull yellowish-brown, conspicuously lenticellate when fully mature; leaves opposite, shortly petiolate, lanceolate- to oblong-elliptic, abruptly and obtusely subcaudate-acuminate, base acute, 6–15 cm. long, 2–6 cm. broad, subcoriaceous, olivaceous, the lower surface somewhat pallid; petioles 0.8–2.0 cm. long; stipules 2, broadly dentiform, 0.1–0.2 cm. long, scarious, caducous; inflorescence corymbose-thyrsiform, lateral (occasionally subterminal ?), bearing 6–18 yellowish flowers; peduncle 2–3 times longer than the subtending petioles; pedicels 1.8–3.0 cm. long, somewhat accrescent after maturity; calyx-lobes ovate to obovate-oblong, obtuse to rounded, unequal, 1.0–1.5 cm. long, scarious, glabrous, the internal squamellae in alternate groups of 2–4; corolla infundibuliform, the proper-tube 1.5–2.0 cm. long, about 0.2 cm. in diameter at the base, the throat tubular-conical, 1.4–1.6 cm. long, about 0.2–0.3 cm. in diameter at the orifice, the lobes obovate-dolabriform, obtuse or rounded, 0.7–1.0 cm. long, spreading; stamens inserted at the base of the corolla-throat, the anthers narrowly oblong, acuminate, narrowly auriculate, 0.5–0.6 cm. long, glabrous; ovary oblongoid, about 0.2 cm. long, glabrous; stigma fusiform, 0.2 cm. long; nectary tubular, subentire or minutely crenulate, somewhat surpassing the ovary; follicles unknown.

BRITISH GUIANA: Essequibo River, Moraballi Creek, near Bartica, alt. near sea-level, Nov. 2, 1929, *Sandwith 552* (K, TYPE, MBG, photograph and analytical drawings); Amakura River, Northwest District, Lat. 8° 10′ N., Long. 60° W., March 23–30, 1923, *Cruz 3542* (MBG, NY).

14. **Odontadenia lauretiana** Woodson & Steyermark, spec. nov.

Suffruticosa volubilis; ramulis teretibus crassiusculis cortice obscure flavo-brunneis juventate minute sparseque puberulis maturitate inconspicue lenticellatis; foliis oppositis petiolatis elliptico-lanceolatis apice acuminatis basi acutis 9–12 cm.

longis 3–4 cm. latis firme membranaceis omnino glabris opacis obscure olivaceis subtus pallidioribus; petiolis 1.2–1.7 cm. longis glabris; stipulis haud visis; inflorescentiis thyrsiformibus subcorymbosis terminalibus 30–50-floris; pedunculo glabro folia subaequante; pedicellis 1.5 cm. longis post maturitatem paulo accrescentibus glabris; bracteis ovato-lanceolatis 0.1–0.3 cm. longis scariaceis caducis; calycis laciniis ovato-oblongis rotundatis paulo inaequalibus 0.6–0.65 cm. longis minutissime papillatis margine ciliolatis intus basi cum sequentibus alternatis uniglanduligeris; corollae infundibuliformis pallide gilvae extus minute sparseque papillatae tubo proprio 1.2–1.4 cm. longo basi ca. 0.2 cm. diametro metiente prope apicem sensim angustato ibique staminigero faucibus tubulo-conicis 3.5 cm. longis ostio ca. 0.6 cm. diametro metiente lobis oblique obovatis ca. 1.5–1.8 cm. longis patulis; antheris anguste oblongo-ellipticis acuminatis anguste auriculatis ca. 0.5 cm. longis dorso glabris; ovario ovoideo minute papillato ca. 0.2 cm. longo; stigmate fusiformi ca. 0.2 cm. longo; nectariis concrescentibus margine minute crenulatis ovario ca. dimidio brevioribus; folliculis ignotis.

Stems terete, relatively stout, minutely and sparsely puberulent when young, glabrate, dull yellowish-brown, inconspicuously lenticellate when fully mature; leaves opposite, petiolate, elliptic-lanceolate, apex acuminate, base acute, 9–12 cm. long, 3–4 cm. broad, firmly membranaceous, glabrous, dull olive-green, opaque, the lower surface somewhat paler; petioles 1.2–1.7 cm. long, glabrous; stipules not seen; inflorescence thyrsiform, subcorymbose, terminal, bearing 30–50 cream-colored flowers; peduncle glabrous, about as long as the subtending leaves; pedicels about 1.5 cm. long, somewhat accrescent after maturity, glabrous; bracts ovate-lanceolate, 0.1–0.3 cm. long, scarious, caducous; calyx-lobes ovate-oblong, rounded, somewhat unequal, scarious, minutely papillate without, margin ciliolate, the internal squamellae alternate, solitary; corolla infundibuliform, minutely and sparsely papillate without, the proper-tube 1.2–1.4 cm. long, about 0.2 cm. in diameter at the base, markedly tapering toward the apex, the throat tubular-conical, about 3.5 cm. long, about 0.6 cm. in diameter at the ori-

fice, the lobes obliquely obovate, 1.5–1.8 cm. long, widely spreading; stamens inserted at the base of the corolla-throat, the anthers narrowly oblong-elliptic, acuminate, narrowly auriculate, about 0.5 cm. long, glabrous; ovary ovoid, about 0.2 cm. long, minutely papillate; stigma fusiform, about 0.2 cm. long; nectaries concrescent, minutely crenulate, about half equalling the ovary; follicles unknown.

PERU: LORETO: edge of forest, Fortaleza, Yurimaguas, alt. 155–210 m., Oct. 30, 1929, *Williams 4385* (B, FM, TYPE, MBG, photograph and analytical drawings).

In many respects *O. lauretiana* provides a connecting link between subgen. *Anisolobus* and *Euodontadenia.* The calyx-lobes are nearly equal, although closely imbricated as in other species of *Anisolobus.* The form of the corolla and the aspect of the foliage are likewise similar to those found in that subgenus. On the other hand, the inflorescence is thyrsiform, thus combining structural characters of the two subgenera. If stipules are proved to be absent, an additional link to *Euodontadenia* will be provided.

15. **Odontadenia Kochii** Pilger in Koch-Gruenberg, Zwei Jahre unter den Indianern **2**: 371. 1910; in Fedde, Rep. Sp. Nov. **8**: 151. 1910.

Stems relatively stout, glabrous, dark reddish-brown, conspicuously lenticellate when fully mature; leaves opposite, petiolate, oblong- to ovate-elliptic, apex abruptly and shortly acuminate, base obtuse to rounded, 6–10 cm. long, 3–6 cm. broad, firmly membranaceous to chartaceous, either surface glabrous, opaque, the lower somewhat paler; petioles 0.8–1.0 cm. long; stipules 2, broadly ovate, 0.1–0.2 cm. long, scarious, caducous; inflorescence corymbose, lateral, bearing 2–6 pale yellowish flowers; peduncle somewhat longer than the subtending petioles, glabrous; pedicels 1.3–1.5 cm. long, somewhat accrescent after maturity, glabrous; bracts ovate-lanceolate, 0.1–0.2 cm. long, scarious, caducous; calyx-lobes ovate to ovate-oblong, obtuse to rounded, 0.7–0.9 cm. long, scarious, minutely puberulent-papillate to glabrate without, the internal squamellae in alternate groups of 3–4; corolla infundibuliform, glabrous without, the proper-tube 1.4–2.0 cm. long, about

0.3 cm. in diameter at the base, the throat tubular-conical, 2.0–2.6 cm. long, about 0.7 cm. in diameter at the orifice, the lobes obliquely obovate, inconspicuously acuminate, 1.3–1.6 cm. long, widely spreading; stamens inserted at the base of the corolla-throat, the anthers oblong-elliptic, acuminate, narrowly auriculate, 0.5 cm. long, minutely papillate dorsally; ovary ovoid, about 0.15 cm. long, glabrous; stigma fusiform-capitate, about 0.15 cm. long; nectaries concrescent, irregularly 5-lobed, about as long as the ovary; follicles relatively stout, divaricate, 8–12 cm. long, densely and minutely velutinous to glabrate, seeds unknown.

BRAZIL: AMAZONAS: in Pflanzung neben Maloka, Dec., 1903, *Koch 70, 73* (B, TYPE, MBG, photograph and analytical drawings); Camanãos, Rio Negro, Dec. 22–23, 1930, *Holt & Blake 592* (MBG, US); same data, *Holt & Blake 594* (US).

16. **Odontadenia Schippii** Woodson, spec. nov.

Fruticosa volubilis alte scandens; ramulis crassiusculis juventate minutissime puberulis cortice flavo-brunneis conspicue lenticellatis; foliis oppositis petiolatis late ellipticis ovalibusve apice in acumen brevissimum obtusum abrupte productis basi obtusis 6.5–12.0 cm. longis 3.0–5.5 cm. latis firme membranaceis glabris supra subnitidulis subtus opacis pallidioribusque; petiolis 1.0–1.5 cm. longis glabris; inflorescentiis thyrsiformibus plurifloris et terminalibus et lateralibus folia aequantibus vel paulo superantibus; pedunculo brevissime puberulo-papillato; pedicellis 2.25–2.5 cm. longis minute denseque puberulo-papillatis; calycis laciniis manifeste inaequalibus exterioribus late ovatis obtusis rotundatisve 0.55–0.6 cm. longis coriaceis extus minute denseque puberulo-papillatis interioribus late oblongis late obtusis 0.9–1.0 cm. longis firme membranaceis extus minute sparseque puberulis; corollae speciosae gilvae extus omnino glabrae intus prope insertionem staminum puberulae caeterumque glabrae ut dicitur paululo suaveolentis tubo proprio 1.5–1.7 cm. longo basi ca. 0.35–0.4 cm. diametro metiente faucibus tubulo-conicis 2.5–2.7 cm. longis ostio ca. 0.5–0.6 cm. diametro metiente lobis oblique lateque dolabriformibus breviter acuminatis 1.3–1.5 cm. longis patulis; staminibus prope basem faucium insertis

antheris oblongo-linearibus acuminatis 0.6 cm. longis dorso minute hirtellis; ovariis ovoideis ca. 0.1 cm. longis glabris; stigmate fusiformi ca. 0.225 cm. longo; nectariis concrescentibus carnosis obfuniformibus ca. 0.3 cm. longis; folliculis ignotis.

Stems relatively stout, minutely puberulent when young, deep brown, conspicuously lenticellate; leaves opposite, petiolate, broadly elliptic to oval, apex shortly and obtusely acuminate, base obtuse, 6.5–12.0 cm. long, 3.0–5.5 cm. broad, firmly membranaceous, glabrous, above somewhat subnitidulous, opaque and paler beneath; petioles 1.0–1.5 cm. long, glabrous; inflorescence thyrsiform, both terminal and lateral, equalling or somewhat surpassing the subtending leaves, bearing several handsome, creamy-white flowers said to be slightly fragrant; peduncle puberulent-papillate; pedicels 2.25–2.5 cm. long, puberulent-papillate; calyx-lobes manifestly unequal, the outer broadly ovate, obtuse or rounded, 0.55–0.6 cm. long, coriaceous, minutely and densely puberulent-papillate without, the inner broadly oblong, obtuse or rounded, 0.9–1.0 cm. long, firmly membranaceous, minutely and sparsely puberulent without; corolla infundibuliform, glabrous without, puberulent within at the insertion of the stamens, otherwise glabrous, the proper tube 1.5–1.7 cm. long, 0.35–0.4 cm. in diameter at the base, the throat tubular-conical, 2.5–2.7 cm. long, about 0.5–0.6 cm. in diameter at the orifice, the lobes obliquely and broadly dolabriform, shortly acuminate, 1.3–1.5 cm. long, spreading; stamens inserted at the base of the corolla-throat, the anthers oblong-linear, acuminate, 0.6 cm. long, minutely hirtellous dorsally; ovaries ovoid, about 0.1 cm. long, glabrous; stigma fusiform, about 0.225 cm. long; nectaries concrescent, fleshy, obfuniform, about 0.3 cm. long, deeply enclosing the ovary; follicles unknown.

British Honduras: Camp 36, Guatemala-B.H. survey, alt. 2800 ft., June 18, 1934, *Schipp S-709* (MBG, type).

Mr. Schipp describes this species as follows: "Tall vine growing in mountain forest, fairly common, but difficult to collect as it grows on the largest of forest trees. Flowers creamy

white with slight odor. 60 ft., stem 3 inches in diameter." *Odontadenia Schippii* is of great interest not only because it is by far the northernmost representative of its genus, but because of its close affinities with several South American species of rather limited distribution, as indicated in the key to species.

17. **Odontadenia gracilipes** (Stadelm.) Woodson, comb. nov.

Echites gracilipes Stadelm. Flora **24**[1]: Beibl. 22. 1841; A. DC. in DC. Prodr. **8**: 455. 1844.

Anisolobus ? gracilipes (Stadelm.) Muell.-Arg. in Mart. Fl. Bras. **6**[1]: 115. 1860.

Mitozus gracilipes (Stadelm.) Miers, Apoc. So. Am. 220. 1878.

Odontadenia goyazensis Glaziou, Bull. Soc. Bot. France **57**: Mem. 3e.: 455. 1910, nom. nud.

Stems terete, relatively slender, ferruginous-pilosulose when young, eventually glabrate and inconspicuously lenticellate when fully mature; leaves opposite, petiolate, oval, apex acuminate, base acute to obtuse, 7–12 cm. long, 2–5 cm. broad, subcoriaceous or firmly chartaceous, opaque, glabrous above, beneath rather irregularly and generally pilosulose; petioles 0.4–1.2 cm. long, pilosulose; stipules minute, flagelliform, numerous; inflorescence corymbose-thyrsiform, lateral, bearing 3–8 pale yellowish flowers; peduncle about 2 to 3 times longer than the subtending petioles, pilosulose; pedicels 1.3–1.4 cm. long, somewhat accrescent after maturity, minutely puberulent-papillate to minutely pilosulose; bracts minutely ovate-reniform, scarious, caducous; calyx-lobes ovate-oblong, unequal, rounded, 0.5–0.8 cm. long, scarious, glabrous or essentially so, the internal squamellae solitary, or in alternate pairs; corolla subsalverform, glabrous without, the tube 1.0–1.4 cm. long, about 0.2 cm. in diameter at the base, the lobes obovate-dolabriform, 0.7–0.8 cm. long, widely spreading; stamens inserted slightly below midway within the corolla-tube, the anthers narrowly oblong-elliptic, shortly acuminate, narrowly auriculate, about 0.4 cm. long, glabrous; ovary ovoid, about 0.15 cm. long, glabrous; nectaries concrescent, subentire, nearly equalling the ovary; follicles unknown.

BRAZIL: MINAS GERAES: in sylvis prope Rio Piranga, April, 1818, *Martius 1034* (M, TYPE, MBG, photograph and analytical drawings); DATA INCOMPLETE: *Sellow 692* (B); *Glaziou 20416* (B).

Sect. 2. ANOMALAE Woodson. Corolla salverform to subsalverform, the tube gradually dilating toward the orifice, but without a conspicuously expanded throat; inflorescence terminal, the subtending leaves indefinitely congested or subverticillate; stipules numerous, filiform, subfoliaceous. *Sp. 18.*

18. Odontadenia anomala (Heurck & Muell.-Arg.) Macbr. Field Mus. Publ. Bot. **11:** 35. 1931.

Anisolobus anomalus Heurck & Muell.-Arg. in Heurck, Obs. Bot. 160. 1870.

Perictenia stipellaris Miers, Apoc. So. Am. 183. *pl. 28.* 1878.

Echites stipellaris Spruce ex Miers, loc. cit. 1878, nom. nud. in synon.

Stems relatively stout, densely ferruginous-hirtellous to glabrate; leaves opposite or irregularly verticillate at the ends of branches, the blade firmly membranaceous, broadly obovate to obovate-oblong, apex rounded with an abrupt and short acumen, base broadly obtuse, 10–20 cm. long, 6.0–13 cm. broad, above drying dark brownish-green, minutely and rather sparsely hirtellous to glabrate, beneath much paler, densely and persistently tomentulose, the petiole 1.0–1.5 cm. long; stipules numerous, filiform, 0.75–1.0 cm. long, subfoliaceous; inflorescence terminal, densely fasciculate-thyrsiform, many-flowered, somewhat shorter than the subtending leaves, minutely and densely hirtellous; pedicels 0.75 cm. long, somewhat accrescent at maturity, the subtending bracts ovate to ovate-lanceolate, 0.5–0.75 cm. long, persistent; calyx-lobes conspicuously dissimilar, broadly ovate, obtuse or rounded, 0.3–0.4 cm. long, densely puberulent without, the squamellae solitary, deeply and irregularly cleft and divided; corolla deep yellow flushed with orange, salverform, glabrous, or minutely and sparsely pilosulose above, the tube narrowly cylindrical, somewhat dilated at the orifice, 2.5–3.0 cm. long, about 0.2 cm. in diameter at the base, the lobes obliquely obovate, acuminate, 3.25–4.0 cm. long, widely spreading; stamens inserted nearly

at the base of the corolla-tube, the anthers narrowly oblong-linear, 0.9–1.0 cm. long, densely puberulent dorsally toward the tip; carpels ovoid, about 0.1 cm. long, densely lanulose; stigma fusiform, 0.15–0.2 cm. long; nectary tubular, irregularly erose, about twice as long as the ovary, sparsely and minutely pilosulose; follicles unknown.

Peru: loreto: Tarapoto, 1855–56, *Spruce 4900* (B, C, Camb., K, V, MBG, photograph and analytical drawings); Stromgebiet des Maranon, Santiago-Mündung am Pongo de Manseriche, 1924, *Tessmann 4034* (S).

Subgen. II. Euodontadenia Woodson, subgen. nov.

Corolla-tube straight, never gibbous or arcuate; calyx-lobes equal or essentially so; inflorescence variously cymose, but not thyrsiform; stipules absent or extremely indefinite; stems not lenticellate, at least above, or very inconspicuously so. *Sects. 3–5.*

Sect. 3. Hoffmannseggianae Woodson. Inflorescence both terminal and lateral, a variously compounded dichasium, frequently aggregate; corolla broadly infundibuliform, the proper tube conspicuously shorter than the throat; anthers densely hirsutulose dorsally; nectary deeply and indefinitely multifid. *Spp. 19–20.*

KEY TO THE SPECIES

a. Corolla 5–8 cm. long, the throat longer than broad.....*19. O. Hoffmannseggiana*
aa. Corolla 3–4 cm. long, the throat about as broad as long..............
....*20. O. stemmadeniaefolia*

19. Odontadenia Hoffmannseggiana (Steud.) Woodson, ex Gleason & A. C. Smith, Bull. Torrey Bot. Club **60**: 392. 1933.

Echites grandiflora G. F. W. Meyer, Fl. Esseq. 131. 1818, not Roxb., Roth, Stadelm., etc.

Echites macrantha R. & S. Syst. **4**: 795. 1819, not Spreng.

Echites Hoffmannseggiana Steud. Nomencl. ed. 2. **1**: 539. 1840.

Echites grandiflora Hoffmsg. ex Steud. loc. cit. 1840, nom. nud. in synon.

Odontadenia speciosa Benth. in Hook. Jour. Bot. **3**: 242. 1841; A. DC. in DC. Prodr. **8**: 360. 1844; Muell.-Arg. in Mart. Fl. Bras. **6**[1]: 117. 1860; Miers, Apoc. So. Am. 126. *pl. 16.* 1878.

Haemadictyon ? grandiflorum (G. F. W. Meyer) A. DC. loc. cit. 426. 1844.

Echites Meyeriana R. & S. ex A. DC. loc. cit. 1844, nom. nud. in synon.

Echites sylvestris A. DC. loc. cit. 464. 1844.

Odontadenia grandiflora Miq. Stirp. Surinam. 166. 1851.

Dipladenia Harrisii Purdie in Hook. Bot. Mag. III. **11**: *pl. 4825*. 1855.

Cylicadenia Harrisii Lem. in Van Houtte, Illustr. Hort. **2**: Misc. 9. 1855.

Odontadenia sylvestris (A. DC.) Muell.-Arg. loc. cit. 1860.

Dipladenia Harrisonii Purdie ex Muell.-Arg. Linnaea **30**: 446. 1860, sphalm.

Odontadenia grandiflora (G. F. W. Meyer) Miers, loc. cit. 127. 1878.

Odontadenia formosa Miers, loc. cit. 1878.

Odontadenia Harrisii (Purdie) Miers, loc. cit. 128. 1878.

Cycladenia Harrisonii Lemaire, ex Miers, loc cit. 1878, sphalm in synon.

Angadenia sylvestris (A. DC.) Miers, loc. cit. 174. 1878.

Odontadenia grandiflora (G. F. W. Meyer) O. Ktze. Rev. Gen. 416. 1891, sphalm.

Odontadenia grandiflora (G. F. W. Meyer) K. Sch. in Engl. & Prantl, Nat. Pflanzenfam. **4**^{2}: 169. 1895, sphalm.

Plants completely glabrous; stems relatively stout; leaves opposite, the blade firmly membranaceous or chartaceous, broadly elliptic to obovate-lanceolate, apex rather abruptly and shortly subcaudate-acuminate, infrequently acute in older leaves, base acute to obtuse, 13–22 cm. long, 4–10 cm. broad, either surface opaque, or the upper somewhat glossy, the petiole 1.25–2.0 cm. long; stipules obsolete; inflorescence lateral, infrequently subterminal, dichasially cymose, frequently much reduced, about equalling the subtending leaves, not rarely much shorter, bearing few to many flowers; pedicels 2.0–2.5 cm. long, somewhat accrescent at maturity, the subtending bracts minutely ovate, persistent; calyx-lobes essentially equal, broadly ovate, obtuse, 0.4–0.6 cm. long, the squamellae solitary, or occasionally geminate; corolla infundi-

buliform, deep yellow tinged with red or orange, the proper-tube 0.5–1.0 cm. long, 0.3–0.5 cm. in diameter at the base, conspicuously constricted at the insertion of the stamens, the throat conical, 2.5–3.5 cm. long, 1.25–1.75 cm. in diameter at the orifice, the lobes obliquely obovate, broadly acuminate, 2.0–3.25 cm. long, widely spreading; stamens inserted at the base of the corolla-throat, the anthers elliptic-sagittate, 1.25–1.3 cm. long, densely hirtellous dorsally; ovary ovoid, about 0.2 cm. long, glabrous; stigma fusiform, 0.4 cm. long; nectary annular, deeply and indefinitely multifid, about half equalling the ovary; follicles relatively stout, more or less falcate, 15–30 cm. long, 1–2 cm. in diameter, glabrous; seeds 3–4 cm. long, the abundant, pale yellowish coma of about equal length.

COSTA RICA: forêts sur les bords du Rio Coto, March, 1896, *Pittier 9881* (Bx).

PANAMA: PANAMA: Trinidad River, alt. 40–80 m., 1911, *Pittier 3976* (G, US); in dense woods, Twin Hill, May, 1862, *Hayes 663* (BB, Bx, Camb., M, V); COLON: Perme, San Blas district, April 24, 1933, *Cooper 261* (MBG, NY).

BRITISH GUIANA: upper Rupununi River, near Dadanawa, May 30, 1922, *Cruz 1418* (MBG, NY); without data, *Schomburgk 309* (B, Camb., D, V).

DUTCH GUIANA: ad fl. Marowyne mediam, date lacking, *Kappler 1989* (B, S); e reg. Para, date lacking, *Wullschlägel 1971* (Bx, V).

FRENCH GUIANA: Acarouany, 1857, *Sagot 383* (D, S, V); Cayenne, date lacking, *Martin s.n.* (B).

BRAZIL: AMAZONAS: Ilha do Frio, Rio Branco, March, 1913, *Kuhlmann 3119* (B, S, U); PARA: Parana do Mirity-pucu (prope faucem fluvii Tocantins), ad ripas inundatis, May 1, 1924, *Kuhlmann 21856* (S); ad oram mer. fl. Amazonum ad ostium flum. Solimoes, June, 1851, *Spruce 1615* (Bx); MATTO GROSSO: on varzia land, river shore, near Tabajaza, upper Machado River region, Nov.–Dec., 1913, *Krukoff 1457* (MBG, NY).

PERU: LORETO: forest, Mishuyacu, near Iquitos, alt. 100 m., Febr.–March, 1930, *Klug 1026* (US).

In founding the genus *Odontadenia* upon *O. speciosa* (= *O. Hoffmannseggiana*), Bentham (loc. cit.) remarked that the immature seeds available for his study were without an apical coma. Sagot, however, noted upon the labels of his specimen cited above: "Flor. aureo lutei ampli, semina papposa!" In all other species of *Odontadenia* of which seed is known, furthermore, the usual apical coma has been observed. Nevertheless, Bentham's opinion concerning the lack of a coma in *O. speciosa* has been maintained, even by recent authors (cf. Markgraf, in Pulle, Fl. Surinam **4**: 48. 1932). Several fruit-

ing specimens have been examined during the course of this study, and it may be stated unequivocably that the seeds of all were found surmounted by an abundant coma. A particularly handsome specimen upon which the seminal coma may be observed is *Kuhlmann 3119* (in Herb. Berol.).

20. Odontadenia stemmadeniaefolia Woodson, Ann. Mo. Bot. Gard. **18**: 548. 1931.

Plants completely glabrous; stems relatively stout; leaves opposite, shortly petiolate, obovate-oblong, apex shortly and obtusely acuminate, base more or less conspicuously cuneate, 15–20 cm. long, 8–10 cm. broad, firmly membranaceous, opaque; petioles 1.0–1.5 cm. long; inflorescence rather irregularly dichasial or aggregate, lateral, somewhat shorter than the subtending leaves, bearing 3–5 showy, reddish-yellow flowers; pedicels 1.0–1.3 cm. long; calyx-lobes equal or subequal, ovate-reniform, about 0.2 cm. long, the squamellae in alternate groups of 2–3; corolla infundibuliform, the proper-tube 0.8–1.0 cm. long, about 0.3 cm. in diameter at the base, the throat broadly conical, 0.7–1.0 cm. long, about 1 cm. in diameter at the orifice, the lobes obliquely obovate-dolabriform, 1.5–2.0 cm. long, widely spreading; anthers narrowly oblanceolate-sagittate, 0.8 cm. long, densely hirtellous dorsally; ovary ovoid, about 0.15 cm. long, glabrous; nectary annular, deeply and indefinitely multifid, somewhat surpassed by the ovary; follicles unknown.

PERU: LORETO: forest, Mishuyacu, near Iquitos, alt. 100 m., Jan., 1930, *Klug 782* (US, TYPE, MBG, photograph and analytical drawings).

Sect. 4. NITIDAE Woodson. Inflorescence lateral, scorpioid, usually simple; corolla salverform or narrowly infundibuliform, the proper tube scarcely narrower than the throat; anthers glabrous to puberulent-papillate dorsally; nectary 5-lobed, the divisions entire to crenulate. *Spp. 21–25.*

KEY TO THE SPECIES

a. Stamens inserted well above the base of the corolla-tube; species of South America (including Trinidad).

b. Leaves obscurely cordate.

c. Corolla narrowly infundibuliform; leaves glabrous throughout. .*21. O. nitida*

cc. Corolla salverform; leaves densely puberulent-papillate beneath...*22. O. hypoglauca*

bb. Leaves not cordate.

c. Corolla salverform, 5–6 cm. long; calyx-lobes 0.4–0.5 cm. long...*23. O. geminata*

cc. Corolla narrowly infundibuliform, 2.5–3.5 cm. long; calyx-lobes 0.1 cm. long...*24. O. glauca*

aa. Stamens inserted nearly at the base of the corolla-tube; plants of Hispaniola...*25. O. polyneura*

21. **Odontadenia nitida** (Vahl) Muell.-Arg. in Mart. Fl. Bras. **6**[1]: 118. 1860; K. Sch. in Engl. & Prantl, Nat. Pflanzenfam. **4**[2]: 169. 1895.

Echites nitida Vahl, Eclog. **2**: 19. *t. 13.* 1798; A. DC. in DC. Prodr. **8**: 453. 1844.

Echites lucida R. & S. Syst. **4**: 795. 1819; A. DC. loc. cit. 475. 1844, not Wall.

Odontadenia cordata A. DC. loc. cit. 360. 1844.

Odontadenia angustifolia A. DC. loc. cit. 1844.

Odontadenia nitida (Vahl) Muell.-Arg. α. *oblongifolia* Muell.-Arg. loc. cit. 119. 1860.

Odontadenia nitida (Vahl) Muell.-Arg. β. *acuminata* Muell.-Arg. loc. cit. 1860.

Odontadenia nitida (Vahl) Muell.-Arg. γ. *angustifolia* (A. DC.) Muell.-Arg. loc. cit. 1860.

Odontadenia lucida (R. & S.) Muell.-Arg. loc. cit. 120. 1860.

Angadenia nitida (Vahl) Miers, Apoc. So. Am. 177. 1878.

Rhabdadenia ? lucida (R. & S.) Miers, Apoc. So. Am. 123. 1878.

Mitozus tenellus Miers, loc. cit. 220. 1878.

Odontadenia Dusendschoenii K. Sch. ex Ule, in Engler's Jahrb. **40**: 403. 1908, nom. nud.

Plants completely glabrous; stems relatively slender; leaves opposite, the blade subcoriaceous, broadly oval to narrowly oblong-elliptic, obtuse to abruptly and shortly acuminate, base broadly and rather obscurely cordate, 7–18 cm. long, 2.5–9.0 cm. broad, drying dark olive-green to brownish, shining above, paler and glaucous beneath, the petiole 1.0–1.25 cm. long; stipules obsolete or essentially so; inflorescence lateral, scorpioid, simple, few- to many-flowered, somewhat surpassing the

subtending leaves; pedicels 0.75–1.0 cm. long, somewhat accrescent at maturity, the subtending bracts minutely ovate-lanceolate, persistent; calyx-lobes essentially equal, ovate to ovate-lanceolate, acuminate, 0.4–0.5 cm. long, the squamellae geminate; corolla infundibuliform, glabrous without, white or pale cream, the proper tube 0.7–1.0 cm. long, about 0.15 cm. in diameter at the base, the throat tubular-conical, 1.7–2.3 cm. long, about 0.6 cm. in diameter at the orifice, the lobes obliquely obovate-dolabriform, obscurely acuminate, 1.5–1.8 cm. long, widely spreading; stamens inserted somewhat below midway within the proper tube of the corolla, the anthers narrowly elliptic-sagittate, 0.7 cm. long, minutely hirtellous dorsally; ovary ovoid, about 0.15 cm. long, glabrous; stigma fusiform, 0.3 cm. long; nectary annular, deeply 5- to many-lobed, about half equalling the ovary; follicles relatively short and stout, parallel to slighty falcate, 8–12 cm. long; seeds about 0.8 cm. long, the pale tawny coma about 2 cm. long.

TRINIDAD: Chancellor's Road, St. Ann's, March 24, 1924, *Broadway 5243* (D, MBG); Pitch Lake, 1891–92, *Warming 239* (C); Piarco Savanna, south of Dabadie, March 18, 1920, *Britton & Hazen 717* (G).

VENEZUELA: Caura-La Botellas, 1902, *Passarge & Selwyn 287* (B).

BRITISH GUIANA: locality lacking, 1858, *Schomburgk 200* (B).

DUTCH GUIANA: in campis (savannis), distr. Para, Febr.–Apr., 1844, *Kappler 1449* (BB, MBG, S); Paramaribo, date lacking, *Wullschlägel 322* (Bx, V); Republiek, Oct. 13, 1911, *Kuiper 40* (B, U).

FRENCH GUIANA: Cayenne, date lacking, *Jelski s.n.* (B).

BRAZIL: PARA: Alemquer, prope flumen, July 28, 1903, *Ducke 21644* (B); MATTO GROSSO: Cuyaba, in silvula ripa rivulis, July 17, 1902, *Malme 1766* (S); Cuyaba, in dumetis ruderalibus ("charravasco") alte volubilis, July 13, 1894, *Lindmann A3563* (S, MBG, photograph)

PERU: LORETO: Yurimaguas, Aug., 1902, *Ule 6272* (B, D); Tarapoto, Sept., 1902, *Ule 6390* (B, D).

22. Odontadenia hypoglauca (Stadelm.) Muell.-Arg. in Mart. Fl. Bras. **6**[1]: 118. *pl. 35, fig. 1.* 1860; K. Sch. in Engl. & Prantl, Nat. Pflanzenfam. **4**[2]: 169. 1895.

Echites hypoglauca Stadelm. Flora **24**[1]: Beibl. 23. 1841; A. DC. in DC. Prodr. **8**: 448. 1844.

Angadenia hypoglauca (Stadelm.) Miers, Apoc. So. Am. 173. 1878.

Angadenia majuscula Miers, loc. cit. 174. 1878.

Stems relatively stout, glabrous; leaves opposite, the blade coriaceous, broadly oval to oblong-elliptic, apex obtuse to rounded, base broadly and obscurely cordate, 7–15 cm. long, 3–8 cm. broad, upper surface glabrous, shining, lower surface glaucous, minutely and densely puberulent-papillate, the petiole 0.75–1.0 cm. long; stipules obsolete; inflorescence lateral, simply scorpioid, glabrous, about equalling or somewhat surpassing the subtending leaves, many-flowered; pedicels 1.0–1.25 cm. long, somewhat accrescent in fruit, the subtending bracts minutely ovate-reniform, caducous; calyx-lobes essentially equal, ovate-oblong, acute to obtuse, 0.4–0.6 cm. long, the squamellae geminate; corolla white or pale cream, salverform, glabrous without, the tube narrowly cylindrical, slightly dilating toward the orifice, 2.5–3.0 cm. long, about 0.3 cm. in diameter at the base, the lobes obliquely obovate, shortly acuminate, 2.0–2.5 cm. long, widely spreading; stamens inserted slightly below midway within the corolla-tube, the anthers narrowly elliptic-sagittate, about 1 cm. long, minutely papillate dorsally; carpels ovoid, 0.2 cm. long, glabrous; stigma fusiform, 2-lobed, 0.3–0.4 cm. long; nectary crown-shaped, deeply 5-lobed, about half as long as the ovary; follicles relatively stout, parallel or slightly falcate, 12–15 cm. long, glabrous; seeds unknown.

BRAZIL: PARA: in vicinibus Santarem, Apr., 1850, *Spruce 680* (Camb., M, V); campo non inundabili, Prainha, May 11, 1903, *Ducke 21645* (B); BAHIA: Maracas, date lacking, *Martius s.n.* (M); in sepibus ad Caiete, date lacking, *Martius s.n.* (M); GOYAZ: data incomplete, *Pohl 1898* (M); MATTO GROSSO: Sta. Anna da Chapada, in ora silva, Jan. 12, 1903, *Malme 3305* (S, MBG, photograph and analytical drawings); Cuyaba, in "cerrado," May 25, 1894, *Malme 1642* (S).

Also reported from Pernambuco by Mueller.

23. Odontadenia geminata (R. & S.) Muell.-Arg. in Mart. Fl. Bras. **6**[1]: 118. 1860; K. Sch. in Engl. & Prantl, Nat. Pflanzenfam. **4**[2]: 169. 1895.

Echites geminata R. & S. Syst. **4**: 796. 1819; A. DC. in DC. Prodr. **8**: 475, 1844.

Echites elegans Benth. in Hook. Jour. Bot. **3**: 249. 1841; A. DC. loc. cit. 1844.

Echites coriacea Benth. loc. cit. 1841; A. DC. loc. cit. 467. 1844, not Blume.

Odontadenia Poeppigii Muell.-Arg. loc. cit. 119. 1860.
Odontadenia coriacea (Benth.) Muell.-Arg. Linnaea **30**: 450. 1860.
Angadenia coriacea (Benth.) Miers, Apoc. So. Am. 177. 1878.
Angadenia elegans (Benth.) Miers, loc. cit. 178. 1878.
Angadenia geminata (R. & S.) Miers, loc. cit. 1878.

Plants completely glabrous; stems relatively slender; leaves opposite, the blade coriaceous or subcoriaceous, broadly oval to narrowly oblong-elliptic, apex obtuse to subacuminate, base obtuse to rounded, 6–12 cm. long, 2.5–7.0 cm. broad, above shining, beneath paler, glaucescent; petiole 0.75–1.0 cm. long; stipules obsolete; inflorescence lateral, simply scorpioid, about equalling or somewhat shorter than the subtending leaves, 2–7-flowered; pedicels 1.5–1.75 cm. long, somewhat accrescent in fruit, the subtending bracts minutely ovate-lanceolate, persistent; calyx-lobes essentially equal, broadly ovate, obtuse or broadly acute, 0.4–0.5 cm. long, the squamellae solitary or occasionally geminate; corolla white or pale cream tinged with yellow, salverform, glabrous without, the tube narrowly cylindrical, slightly dilated toward the orifice, 2.5–3.0 cm. long, about 0.3 cm. in diameter at the base, the lobes obliquely obovate, shortly acuminate, 2.5–3.0 cm. long, widely spreading; stamens inserted about midway within the corolla-tube, the anthers narrowly elliptic-sagittate, 0.9–1.0 cm. long, minutely papillate dorsally; ovary ovoid, about 0.15 cm. long, glabrous; stigma fusiform, 0.3 cm. long; nectary annular, deeply 5-lobed, somewhat shorter than the ovary; follicles relatively short and stout, parallel to slightly falcate, 8–10 cm. long, glabrous; seeds unknown.

British Guiana: Kamakusa, upper Mazaruni River, July 11–22, 1923, *Cruz 4211* (MBG, NY); Kakburi, Pomeroon District, Febr. 10–15, 1923, *Cruz 3251* (US); Waini River, Northwest District, April 3–18, 1923, *Cruz 3703* (US).

Dutch Guiana: Wonotobo, Oct., 1916, *Stahel & Gonggrijp 2862* (B, U).

Colombia: caqueta: Rio Caqueta ad cataractas Cupati, in ripis, Dec. 1, 1912, *Ducke 21821* (B).

Brazil: amazonas: Vista Alegre, Rio Branco, in campis, March, 1913, *Kuhlmann 2917* (B, S, MBG, photograph and analytical drawings); prope San Gabriel da Cachoeira, ad Rio Negro, Jan.–Aug., 1852, *Spruce 2083* (Camb., V, MBG, photo-

graph); prope San Carlos, ad Rio Negro, 1853–54, *Spruce 3152* (M, V); PARA: Bôa Vista on the Tapajos River, May–June, 1929, *Dahlgren & Sella 74* (B, FM, MBG, S); Faro, campina arenosa, Sept. 24, 1907, *Ducke 21650* (B); on varzia land, near Cassipa, Tapajos River region, Sept., 1931, *Krukoff 1247* (MBG, NY).

24. **Odontadenia glauca** Woodson, Ann. Mo. Bot. Gard. **18**: 550. 1931.

Plants glabrous throughout; stems relatively slender; leaves opposite, shortly petiolate, obovate-oblong, apex shortly and acutely acuminate, base obtuse or rounded, 6–8 cm. long, 3.5–4.5 cm. broad, coriaceous, lustrous above, glaucous beneath; petioles 0.3–0.5 cm. long; inflorescence lateral, scorpioid, somewhat shorter than the subtending leaves, bearing 3–5 white or cream-colored flowers; pedicels 1 cm. long; calyx-lobes subequal, ovate-trigonal, acutish, about 1 cm. long, scarcely imbricated, the alternate squamellae solitary; corolla infundibuliform, glabrous without, the proper tube 0.8–1.0 cm. long, about 0.1 cm. in diameter at the base, the throat tubular-conical, 0.7–1.0 cm. long, the lobes obliquely dolabriform, 1.0–1.5 cm. long, spreading; stamens inserted about midway within the corolla-tube, the anthers narrowly oblong-sagittate, 0.6 cm. long, glabrous; ovary ovoid, about 0.1 cm. long, glabrous; stigma 0.15 cm. long; nectary deeply 5-lobed, somewhat surpassing the ovary; follicles unknown.

VENEZUELA: AMAZONAS: Cerro Yapacana, upper Rio Orinoco, alt. about 100 m., April, 1931, *Holt & Blake 750* (US, TYPE, MBG, photograph and analytical drawings).

25. **Odontadenia polyneura** (Urb.) Woodson, Ann. Mo. Bot. Gard. **18**: 546. 1931.

Rhabdadenia polyneura Urb. Symb. Ant. **7**: 337. 1912.

Plants completely glabrous; stems relatively slender, reddish-brown, not lenticellate or very inconspicuously so; leaves opposite, petiolate, oblong- to obovate-elliptic, apex acute to acuminate, base obtuse to rounded, 3.5–8.0 cm. long, 1–4 cm. broad, firmly membranaceous, above olivaceous, slightly nitidulous, beneath paler and more or less glaucous, the midrib and veins somewhat verrucose; petioles 0.5–1.0 cm. long; stipules obsolete; inflorescence scorpioid, simple, lateral, opposite, somewhat surpassing the leaves, bearing 6–10 white or cream-

colored, showy flowers; pedicels 0.9–1.0 cm. long, somewhat accrescent after maturity; bracts ovate-lanceolate, 0.1–0.3 cm. long, scarious, caducous; calyx-lobes ovate, broadly acute, essentially equal, 0.3–0.4 cm. long, glabrous without, the squamellae in alternate groups of 3–6; corolla infundibuliform, glabrous without, the proper-tube 0.4–0.5 cm. long, about 0.3 cm. in diameter at the base, the throat narrowly campanulate, 1.3–1.5 cm. long, about 0.7–0.8 cm. in diameter at the orifice, the lobes obliquely obovate, shortly acuminate, 1.5–1.7 cm. long, widely spreading; stamens inserted nearly at the base of the corolla-tube, the anthers narrowly elliptic-lanceolate, narrowly auriculate, 0.8 cm. long, glabrous; ovary broadly ovoid, about 0.15 cm. long, glabrous; stigma fusiform, 0.2 cm. long; nectaries 5, concrescent at the base, truncate or somewhat emarginate, about half as long as the ovary; follicles unknown.

SANTO DOMINGO: inter Constanza et Rio Jimenoa in Loma del Hato quemado, alt. 1400 m., in sylvis, June, 1910, *Tuerckheim 3341* (B, TYPE, MBG, S).

Also reported from Haiti by Urban (loc. cit.).

Sect. 5. LAXIFLORAE Woodson. Inflorescence both terminal and lateral, laxly and irregularly compound, dichasial to scorpioid or helicoid; corolla infundibuliform, relatively small; anthers glabrous; nectary annular, essentially concrescent. *Sp. 26.*

26. Odontadenia laxiflora (Rusby) Woodson, Ann. Mo. Bot. Gard. **19**: 386. 1932.

Laubertia (?) laxiflora Rusby, Bull. N. Y. Bot. Gard. **4**: 408. 1907.

Codonechites paniculata Mgf. Notizblatt **9**: 80. *fig. 2 A–E.* 1924.

Plants completely glabrous; stems relatively slender, light greenish- to reddish-brown, not lenticellate above or very inconspicuously so; leaves opposite, shortly petiolate, oblong-elliptic, apex shortly subcaudate-acuminate, base acute to obtuse, 8–13 cm. long, 2.5–4.0 cm. broad, membranaceous to subchartaceous, above pale olivaceous, nitidulous, beneath somewhat paler, opaque; petioles 0.4–0.6 cm. long; stipules obsolete; inflorescence laxly and irregularly compound, dichasial

to scorpioid or helicoid, both terminal and alternate-lateral, about twice surpassing the leaves, bearing 20–30 white or cream-colored flowers; pedicels 1.0–1.2 cm. long, somewhat accrescent in fruit; bracts minutely ovate-trigonal, scarious; calyx-lobes ovate, broadly acute, 0.2–0.25 cm. long, glabrous without, the squamellae in alternate groups of 2–4; corolla infundibuliform, glabrous without, the proper-tube 0.6–0.7 cm. long, about 0.15 cm. in diameter at the base, the throat rather narrowly campanulate, 0.7–0.8 cm. long, about 0.5 cm. in diameter at the orifice, the lobes obliquely obovate, shortly acuminate, 0.5–0.6 cm. long, widely spreading; stamens inserted at the base of the corolla throat, the anthers elliptic-lanceolate, acuminate, narrowly auriculate, 0.35 cm. long, glabrous; ovary broadly ovoid, about 0.1 cm. long, glabrous; stigma fusiform-subcapitate, obscurely digitate below, 0.15 cm. long; nectaries essentially concrescent, truncate, fleshy, about half as long as the ovary; follicles unknown.

Bolivia: data incomplete, *Bang 2056* (NY, type, MBG, photograph and analytical drawings).

Brazil: Rio Acre, Seringal bei S. Francisco, March, 1911, *Ule 9698* (B, MBG, photograph).

It does not appear possible to recognize *O. laxiflora* as constituting a distinct genus without raising to generic rank also other entities of the inclusive genus *Odontadenia* interpreted as sections in this revision.

EXCLUDED OR UNCERTAIN SPECIES

Odontadenia cuspidata Rusby, Descr. So. Am. Pl. 89. 1920 = **Mandevilla cuspidata** (Rusby) Woodson, Ann. Mo. Bot. Gard. **20**: 730. 1933.

Odontadenia glandulosa (R. & P.) K. Sch. in Engl. & Prantl, Nat. Pflanzenfam. **4²**: 169. 1895 = **Mandevilla glandulosa** (R. & P.) Woodson, Ann. Mo. Bot. Gard. **19**: 66. 1932.

Odontadenia gracilis K. Sch. in Glaziou, Bull. Soc. Bot. France **57**, Mem. 3e.: 455. 1910, nom. nud.

Anisolobus lancifolius K. Sch. in Glaziou, loc. cit. 1910, nom. nud.

(To be continued)

CYTOLOGY OF GEOTRICHUM VERSIFORME MOORE[1]

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INTRODUCTION

The purpose of this paper is to report a study of the cytology and nuclear phenomena in the development of *Geotrichum versiforme,* a fungus which was described morphologically and culturally in a previous report by the author (Moore, '34).

As far as the writer is aware, there has been no cytological study of the genus *Geotrichum,* except for the suggestion that the arthrospores were possibly uninucleate cells. Guilliermond ('00), in describing the structure of *Oidium lactis,* gave indications of the mycelial structure of that organism, while Jannin ('13) referred to the cytology in Guilliermond's paper as representing the type present in Mycodermata. Inasmuch as *Geotrichum* has a structure and development often confused with and similar to *Mycoderma, Oidium,* and perhaps *Oospora* and *Monilia,* the work of the above two writers may be taken to represent the previous work on the subject. This may further be emphasized by the fact that certain Oidia, Mycodermata, and others have been shown to be synonymous. However, the life cycle of *Geotrichum versiforme* seemed, on superficial examination, to differ in several factors from that of the other genera. In addition, a newer technique for work of this sort led the author to the study here described.

MATERIALS AND TECHNIQUE

It has been shown that the fungus has different aspects on various media, and that maltose increased the growth of the

[1] Preliminary report presented before the Mycological Society of America, December 30, 1933, at the winter meeting of the American Association for the Advancement of Science, held at Boston, Massachusetts.

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organism. Consequently, Sabouraud's glucose and maltose agar were used as substrates. The former develops all the features found in the life cycle, and the latter, because of the maltose, produced many of the irregularities in morphology, such as large sclerotic cells. Cultures on agar slants of these media were fixed with Hermann's fluid, embedded in celloidin, sectioned, and stained with iron-alum haematoxylin as described by the author (Moore, '33) for *Endomyces*.

For the observation of the cellular constituents, as fat, glycogen, volutin, and the like, several chemicals were used which will be described under their respective headings.

CYTOLOGY

Since there has been no definite relationship established with the Ascomycetes, by means of ascospores, the arthrospore must be considered as the germ of the colony. It would thus seem advisable to trace the development of a mycelium with that cell as the initial stage. The single arthrospore (pl. 7, fig. 1) is uninucleate, with a fairly thick wall or membrane. Germination proceeds, usually laterally, by sending out a thin tube, the germ-tube, which at first has the appearance of a small bud but later becomes a thin-walled hypha. This contains many granules near its apex which are probably volutin. The nucleus is seen as a large granular structure with a heavily staining nucleolus. With the germination of the arthrospore, nuclear division takes place, by simple fission as far as could be determined (pl. 7, fig. 3). Although many nuclear divisions were examined, it cannot be stated definitely that mitosis was present. The process continues until there may be as many as eight nuclei in the germinating cell, but usually there are only two or three (pl. 7, fig. 2).

The germ cell itself contains a granular and reticulated protoplasm of metachromatic material. In many of the germ-tubes, there seems to be a vacuolated area near the apex (pl. 7, fig. 3). After a number of nuclei have apparently entered into the germ-tube, the hypha is ready to form cross-walls. In the young filaments this is accomplished by a pinching in or a transverse abscission of the walls of the hypha. This may take

place between a dividing nucleus as in pl. 7, fig. 4, or between separated nuclei. The cell elongates and nuclear division continues, chiefly at the terminal portion. The nuclei may divide laterally (pl. 7, figs. 6, 8), giving the appearance in a later stage of alternate nuclei (pl. 7, figs. 8, 11, 12), or longitudinally (pl. 7, figs. 9, 12). The young filaments elongate and may be simple or branched (pl. 7, figs. 8–12; pl. 8, fig. 22) as explained in the previous paper (Moore, '34). When these become mature, cross-walls are again laid down, but at this time they are formed by a thickening of the region where the partition is to develop (pl. 7, figs. 9–10). These may be simple or collar-like (pl. 8, figs. 22, 24). With their formation, the resulting cells become uninucleate (pl. 7, figs. 13, 16) and are now the arthrospores. In addition to the reticulated network in the cell noted previously, there is a heavy granulation on the inner surface of the wall (pl. 7, figs. 16, 18; pl. 8, fig. 24) which seems to be noticed more often in the arthrospores.

An important feature in the filaments is the presence of clear, non-granulated, thin-walled cells, apparently devoid of cytoplasm (pl. 7, fig. 19; pl. 8, figs. 20–22, 24, 26–27, 32, 48, 53). What this lack of protoplasm indicates cannot be explained unless it is that the contents were used up in the nourishment of the adjoining cells.

On maltose agar the cells are much enlarged, especially those submerged. Here the peculiar condition arises of many long hyphae devoid of protoplasm with clusters of short branches of arthrospores as in pl. 8, fig. 22. Also, there are series of empty cells and arthrospores (pl. 8, fig. 24). These intercalary arthrospores give rise to chains of small arthrospores while still attached to the filament.

In addition to the regular development of the fungus, there are several structures which must be given consideration. The first of these is the chlamydospore. This particular organ which can generally be distinguished by its apparent large size and thick wall is found here (pl. 7, figs. 7, 17, 19; pl. 8, figs. 20–21, 23) in much the same condition as the arthrospores. It is a coenocytic structure which has a heavily granulated, reticular network and may occur terminally as a spherical body.

They may be found as spherical, cylindrical, intercalary structures (pl. 8, figs. 27, 48, 53) or in chains as sclerotic, thick-walled cells (pl. 7, fig. 19; pl. 8, figs. 20–21). Chlamydospores germinate (pl. 7, figs. 7, 17) and give rise to mycelium.

The so-called blastospores are seen as granulated, nucleated cells, the nuclei varying in number from one to three, frequently one. The conidia, considered by many to be possibly blastospores, have been found to have a heavily granulated protoplasm with no indication of a nucleus. A nucleus if present would be masked probably by the accumulated, heavily stained material within the cell. All indications, however, point to the absence of a nucleus, which would therefore justify the retention of the term conidium for that cell, as has been pointed out by the author.

Cellular contents.—Not all the constituents of the cell have been identified, but those that have will be considered here. It has been shown by many authors that fungi tend to store food in the cell, particularly in the older mycelium. These reserve products are usually in the form of glycogen, lipoids, oil globules, metachromatic granules of Guilliermond or nuclear decomposition products, as volutin, nucleic acid substances, and probably other protein derivatives and carbohydrates. Since most of these substances have been demonstrated and discussed by the author for *Endomyces,* it will suffice to mention here merely their presence and quantity and the technique employed.

Volutin.—Volutin or metachromatic material is very easily demonstrated with methylene blue or even iron-alum haematoxylin, as substances within the cell, usually along the inner surface of the cell wall (pl. 7, figs. 16, 18) or along the reticulated network. A pinch of benzidine sulphate added to a water mount of living material reveals a number of granules (pl. 8, figs. 33–41), particularly the so-called "dancing bodies" which are precipitated volutin in a state of Brownian movement. These take a blue coloration. According to the work of Bertrand (cited in Guilliermond, Mangenot and Plantefol, '33), benzidine produces with peroxidases a blue coloration.

Glycogen.—With neutral red and iodine potassium iodide, glycogen may be easily demonstrated. Neutral red shows this material as large, pink to red drops (pl. 8, figs. 25–27). The older cells have larger and more deeply colored drops than do the younger cells. With saturated iodine potassium iodide (pl. 8, figs. 28–32) glycogen is seen as orange-brown, irregular bodies spread throughout the cell. As in the case of neutral red, there is a greater amount in the older than in the younger cells.

Vacuoles.—The presence of vacuoles is easily demonstrated with methylene blue or haematoxylin, as surrounded by the reticulum (pl. 7, fig. 19). Iodine potassium iodide (pl. 8, figs. 28, 31) shows the vacuoles very clearly, while benzidine sulphate (pl. 8, figs. 36–41), as used previously, shows them to best advantage, most of them containing the "dancing bodies." Neutral red also brings out the vacuoles.

Chondriosomes.—Chondriosomes or mitochondria may be demonstrated with iodine potassium iodide. They are seen as light yellow, refractile droplets of various sizes. With benzidine sulphate they are supposed to take a light blue color and are distributed as droplets throughout the cell (pl. 8, figs. 33–35), and where vacuoles are present surround the vacuolar membrane (pl. 8, figs. 36, 40). Guilliermond has demonstrated them in *Oidium lactis* with benzidine. These bodies are few in young cells and abundant in older cells.

Fat, lipoidal substances.—In addition to the substances listed above, lipoidal substances, fats, and various other reserve materials, as well as secretion and excretion materials, can be demonstrated easily. They are found in varying amounts in the cells. These have also been discussed previously by the author.

Several agents can be used very favorably to study these materials, each showing some degree of difference. With 2 per cent osmic acid (pl. 8, figs. 42–48) these substances are reduced and take a black coloration. They are found as small globules or droplets in the young mycelium (pl. 8, fig. 47) and as larger, heavier masses usually in the center of the older cells. Much

the same picture is presented with 5 per cent platinic chloride solution (pl. 8, figs. 49–53). With iodine potassium iodide as applied for glycogen and chondriosomes, fats and lipoidal substances are seen, with careful focusing, as very small, highly refractile and hyaline bodies.

DISCUSSION AND CONCLUSIONS

It is not intended in this paper to formulate any new theories as to cytological pictures, but merely to interpret the phenomena involved in the development of *Geotrichum versiforme.* To summarize briefly, the uninucleate arthrospore serves as the spore for new mycelia. It germinates, forming a thin-walled tube which becomes multinucleate and when well elongated develops cross-walls to form coenocytic cells. These cells mature and secondary partitions are formed by a thickening and subsequent gelatinization of a particular portion of the hypha. This process therefore gives rise to cells which are the uninucleate arthrospores.

The division of the nucleus, as has been pointed out previously, is apparently direct or amitotic and may take place longitudinally or transversely in the cell. In the former case, cross-walls can be seen forming at the point of division, while in the latter the nuclei appear alternately on the sides of the hypha, due to the growth of the filament. Nuclear phenomena in *Oidium lactis* as described by Guilliermond ('00) are revealed by simple division into two masses within an areola. Dangeard, Janssens and Leblanc, and a host of others cited by the present author considered this division as mitotic, with the phenomena masked. In *Geotrichum,* as observed here, the light region or areola surrounding the nucleus is lacking. Darkly staining central portions may be seen which represent the nucleoli, but definite karyokinesis with chromosomal formation cannot be distinguished.

Chlamydospores are found as coenocytic, enlarged, sclerotic, thick-walled cells. So-called blastospores are present as nucleated structures, while granular, apparently non-nucleated conidia can be distinguished.

Volutin, glycogen vacuoles, chondriosomes, and additional storage or reserve materials, as well as fat and lipoidal substances, can be demonstrated in varying amounts by means of several agents.

ACKNOWLEDGMENTS

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Explanation of Plate

PLATE 7

Geotrichum versiforme

All figures drawn as correctly as possible with the aid of a camera lucida. All grown on Sabouraud's glucose agar. Figure 10 drawn at × 1440, all others drawn at × 2300; plate reduced approximately one-half.

Figs. 1–4. Germinating arthrospores.

Fig. 5. Cells formed from a germinating arthrospore.

Fig. 6. Arthrospore showing type of nuclear division.

Fig. 7. Germinating chlamydospore.

Fig. 8. Advanced stage of fig. 5, showing cell formation and multinucleate condition.

Figs. 9–10. Coenocytic cells with the beginning of cross-wall formation.

Figs. 11–12. Branching hyphae showing young coenocytic cells becoming uninucleate arthrospores.

Fig. 13. Filament of cells with arthrospore formation.

Fig. 14. Cells showing nuclear condition and division.

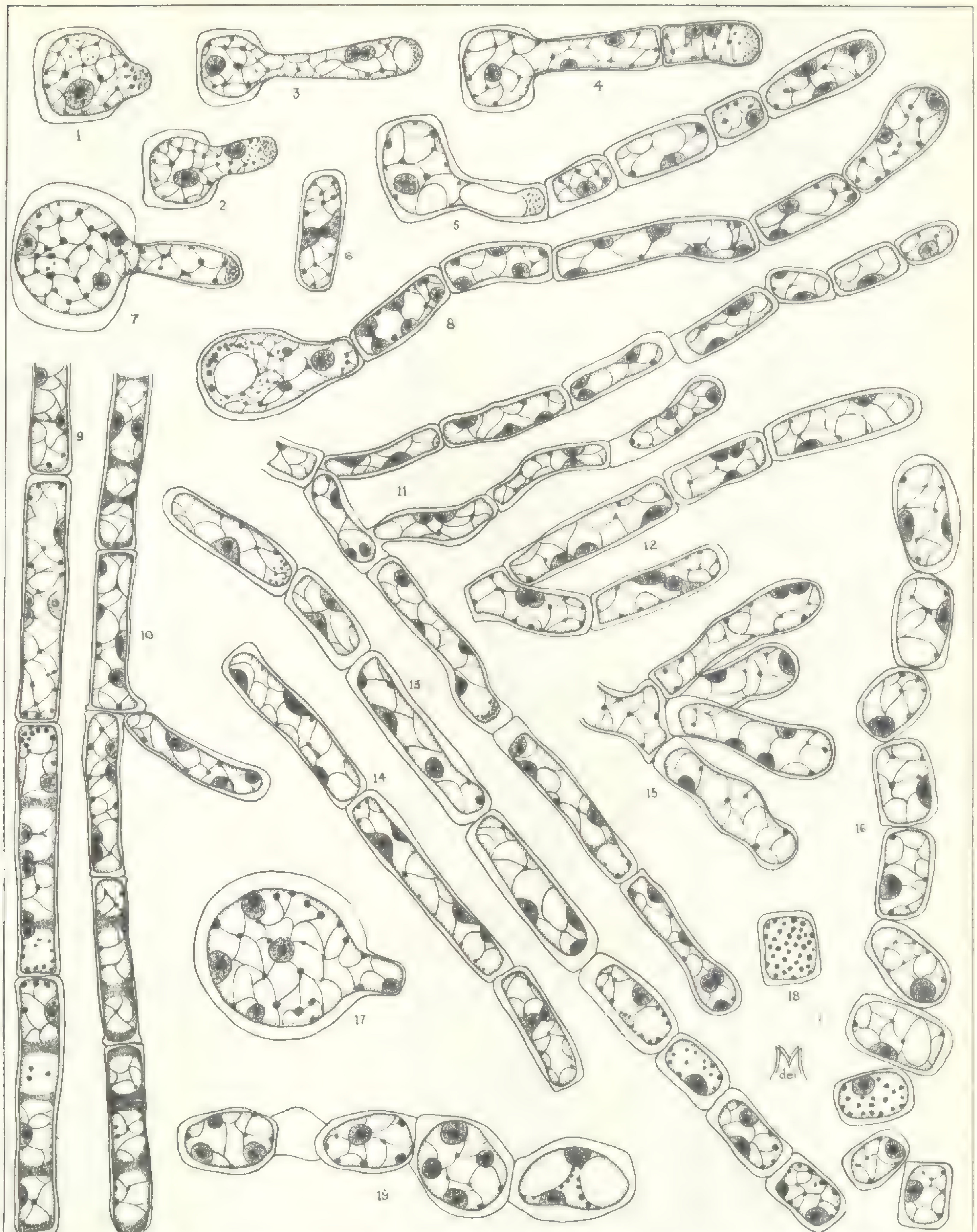
Fig. 15. Branching condition.

Fig. 16. Chain of arthrospores.

Fig. 17. Germinating chlamydospore.

Fig. 18. Arthrospore showing granular appearance of inner wall.

Fig. 19. Chain of cells, probably chlamydospores.



MOORE—GEOTRICHUM VERSIFORME

Explanation of Plate

PLATE 8

Geotrichum versiforme

All figures drawn as accurately as possible with the aid of a camera lucida. Figures 25–27 drawn at × 1440, all others drawn at × 2300; plate reduced approximately one-half.

Figs. 20–21. Coenocytic cells, probably chlamydospores, on Sabouraud's glucose agar.

Fig. 22. Branching condition of mycelium submerged in Sabouraud's maltose agar.

Fig. 23. Large round chlamydospores on the same medium.

Fig. 24. Mycelium on the same medium.

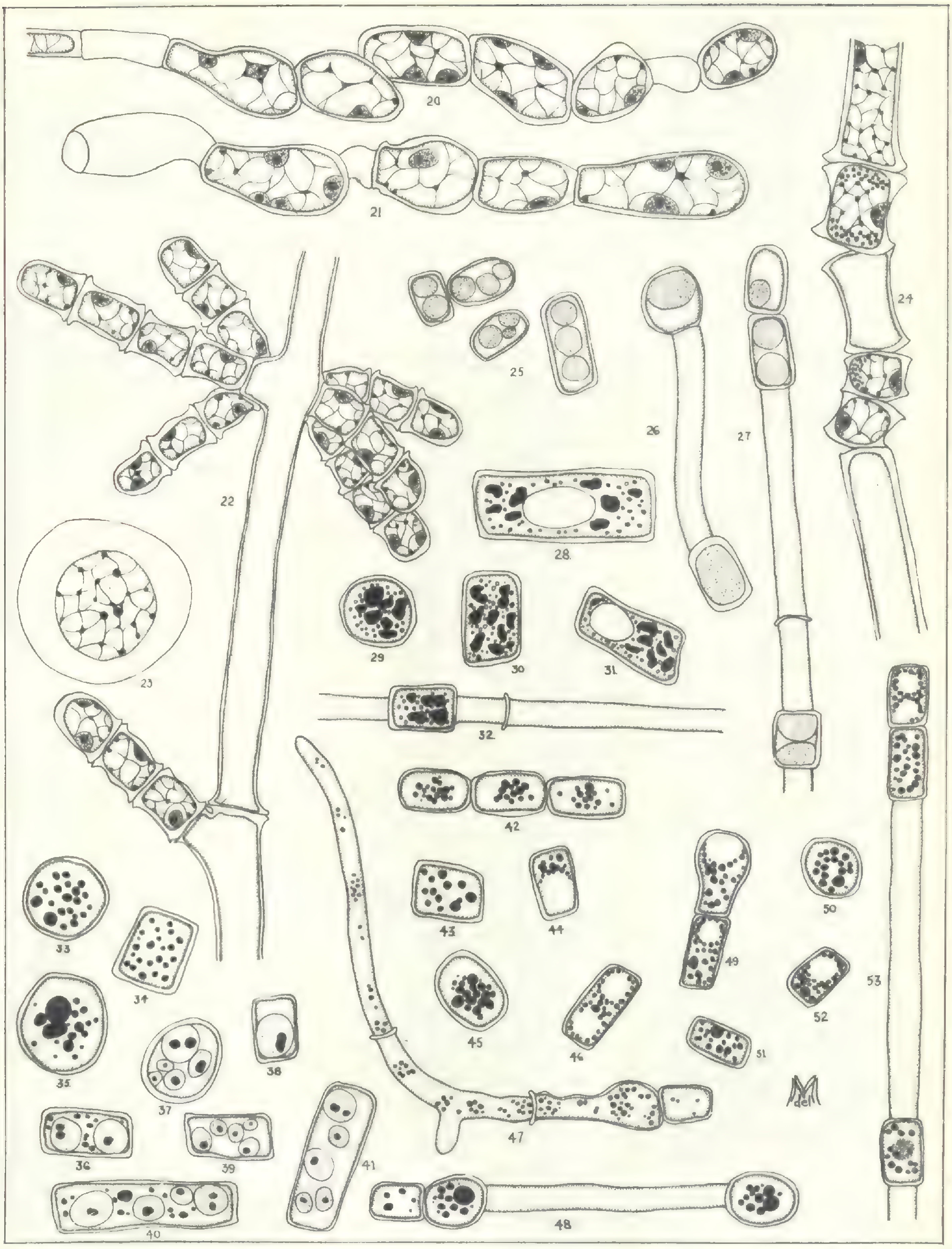
Figs. 25–27. Whole cells mounted in neutral red, showing volutin content.

Figs. 28–32. Cells mounted in iodine potassium iodide, showing glycogen as the heavily stained material, lipoidal substances as small granular hyaline bodies, and probable chondriosomes as small dark bodies.

Figs. 33–41. Living cells mounted in distilled water to which was added a pinch of benzidine sulphate, showing vacuoles with dancing bodies, probably volutin.

Figs. 42–48. Living cells mounted in 2 per cent osmic acid, showing fat content.

Figs. 49–53. Cells mounted in 5 per cent platinic chloride, showing fat content.



MOORE—GEOTRICHUM VERSIFORME

HEAD INFECTION CAUSED BY A NEW HEMISPORA: H. COREMIFORMIS[1]

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INTRODUCTION

Hemisporosis, as a clinical entity, has been established since 1909, when Gougerot and Caraven ('09) cultured an organism from fragments of an infected tibia. It resembled and was at first diagnosed as a syphilitic periostitis, but was found to be an osteo-periostitis. Later cultural studies (Gougerot and Caraven, '10) on various media proved that the organism was similar to *Hemispora stellata,* a species which Vuillemin had isolated from *Aspergillus repens* and had described in detail (Vuillemin, '06). Since then Castellani has isolated another species, *Hemispora rugosa,* from cases of bronchitis and tonsillitis and from the vulva (Castellani, '25). He also described a third species, *H. pararugosa* Castellani, Douglas and Thompson, but stated that it was probably only a variety of *H. rugosa.*

The disease was later confirmed by several writers, notably Auvray ('09), who described a gummatous infection or infiltration of the neck and face. De Beurmann, Clair, and Gougerot ('09) reported a case which showed cold abscesses of the penis, and there have also been cases of nasal involvement, cheek infections, and subcutaneous ulcerating gummas on the back (Balzer and Belloir, '13). Porcelli ('22) found an infection of the nose, the first case of hemisporosis from Italy. Other cases have been reported, but since the literature has been summarized (Grütz-Elberfeld in the Handbuch der Haut- und

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Issued May 25, 1935.

Geschlechtskrankheiten, '28), a complete review here would be unnecessary.

The organism described in this paper, morphologically, culturally, and physiologically, was isolated from an infection of the head by Peña Chavarria of Costa Rica. An abstract of the case, which is in press, in the Archiv für Schiffs- und Tropenhygiene, Hamburg, was kindly sent the author by Chavarria.

CASE REPORT

M. A. V., a farmer, 34 years of age, living at Turrialba (Atlantic slope), a region from which a patient with a similar infection had been treated six years previously. Patient entered the hospital on June 13, 1932, with an infection due to scratching bee bites with soiled hands. A small vesicle formed at the center of his forehead, which when scratched exuded a clear liquid. He received medical treatment quite early (injections of Antimosan, an antimony preparation), but new lesions which followed the course of the former one appeared on his forehead, back of the neck, and on the upper extremity of the right ear.

The patient showed no history of syphilis or tuberculosis, but of several of the tropical, parasitic diseases, including malaria. Wassermann negative.

The patient is well-built, in a good state of health on a general physical examination. The skin infection, however, shows a large lesion on his forehead, 4 x 5 inches, with the surface and edges slightly raised and irregular. The color is brass red, simulating a syphilitic lesion. The tissues are infiltrated, with no pain to the touch. There is an occasional pruritus. Along the left eyebrow there are four elements which tend to evolve as did the other on the forehead. On the edge of the right ear there are several small papulo-verrucoid lesions, some of which show suppuration. There are also lesions on the angle of the right jaw. Scars on the clavicular region of the same side correspond (according to the patient's statements) to the above lesions. Repeated examinations of material from the lesions showed always yeast-like organisms.

The patient was treated with iodine and tartar emetic intravenously and antiseptics locally, with healing resulting in two months.

TECHNIQUE

Cultural studies were made of the organism from a fairly wide variety of substrates. The morphology was studied in distilled water mounts, in Amann's lacto-phenol, and mounts in crystal violet in glycerine (1 per cent crystal violet to the desired intensity in glycerine). Details of the cellular and spore development were observed from hanging-drop and slide mounts in 2 per cent bacto-peptone, lactose broth (Difco), and beef extract broth (Difco).

DESCRIPTION

The microbe studied was obtained on a Sabouraud's glucose agar slant, growing as a yeast-like organism and appearing culturally as a vermiculate growth. The parasite exists in the host as a yeast-like organism with budding cells (pl. 9, fig. 1) 4–6 μ in diameter. These cells are thick-walled and appear double-contoured. When transferred to an artificial substrate they elongate to form sclerotic cells, simulating germinating spores (pl. 9, fig. 1). The organism exists in this state for a variable length of time, depending on the medium in which it is grown, the temperature, and other growth factors.

With repeated subculturing in most cases of yeast-like organisms, it is possible to obtain a filamentous type of fungus. In this case, the microbe was subcultured twice, and showing no appreciable change morphologically or culturally, was stored in the ice-box for approximately five months. It was then subcultured twice, after which it underwent several changes, physiologically and morphologically. This development may be attributed to the adaptation of the organism to a saprophytic form of life on the artificial medium. The reaction involved, in addition to the different substrate, a changed pH, nitrogen and carbohydrate source.

On most media the cells elongate to form long filamentous hyphae (pl. 9, figs. 2, 10). The cells may be long and thin, or short and narrow (pl. 9, fig. 35), or they may be thick (pl. 9, fig. 36). On the other hand, the mycelium may consist of simple or branched chains of yeast-like cells simulating oidia or arthrospores as on Richards' (pl. 9, fig. 21) and Raulin's agar (pl. 9, fig. 22), or there may be combinations of both types (pl. 9, fig. 28; pl. 10, fig. 73). On wort agar, a medium which is particularly adapted to yeast cultivation, the organism develops, in addition to cylindrical cells, spherical or ovoid structures with a heavy gelatinous wall or envelope, from which the cell either grows or slips out (pl. 9, fig. 19; pl. 10, figs. 51–52, 54–59, 61–62, 66, 68, 70). This type of structure is also evident on malt-extract agar (pl. 9, fig. 26) which is a modification of wort agar.

With the formation of hyphae, which may vary from 2 to 4 μ in diameter, there are formed also intercalary chlamydospores (pl. 9, fig. 9) either spherical, 6–10 μ in diameter, or ovoid or elongate, 7–9 × 12–15 μ or larger. Usually, however, there may be seen, in mounts of mycelium, large spherical cells (pl. 9, fig. 32) floating freely. On wort agar, large cells 6–17 μ in diameter (pl. 10, fig. 51) are in abundance. Conidia (pl. 9, fig. 9), usually pyriform, at times spherical, 4–6 μ in diameter, are found frequently and germinate (pl. 9, figs. 23–25) to form hyphae. Blastospores (pl. 9, fig. 10; pl. 10, fig. 73) are also found.

The formation of the hyphae is further emphasized by the production of spherical, globose or sub-clavate to clavate cells at the apex of the filament (pl. 9, figs. 26–30, 33–34; pl. 10, figs. 37–38, 41–44, 49–50, 60, 63–64, 68–69, 72–73). These cells may also be ampulliform (pl. 10, figs. 45–46) and Vuillemin considers them to be protoconidia or hemispores which later divide to form several spore-like cells termed deuteroconidia. In the growth of the filament, cross-walls are laid down much as in the arthrospore-producing organisms, which accounts partially for the systematic position of the fungus and also for its confusion with other genera.

The hyphae may branch and give rise to several filaments which undergo the same process of laying down cross-walls by a growth inward of the cell wall. The formation of the primary partitions is followed by that of secondary walls which form the catenulate conidia or arthrosporous cells (pl. 10, fig. 37). These cells, which vary in number and size, are formed by an almost simultaneous cross-wall production. They are usually preceded by a thickening of the filament wall, giving the appearance of a constriction, so-called by Vuillemin and Castellani (pl. 9, figs. 30, 34; pl. 10, figs. 44, 50). Where there are a number of adjacent branches, coremia are formed (pl. 10, fig. 70), with large heads of many of the arthrosporous spherical or ovoid cells. The presence of coremia is noted on most solid media, but not in liquid substrates.

The cells of the filaments, as stated above, may be arthrosporous, spherical, cylindrical, or ovoid. In addition, there are

sections of the hypha which are thin-walled and have no apparent cellular material (pl. 9, figs. 14, 19–20, 26–30; pl. 10, figs. 38, 41–50, 70, 72–73). This makes the intercalary cells appear as isolated chlamydospores, comparable to akinetes in the algae as pointed out for *Geotrichum* in a previous paper (Moore, '34).

When the partitions are finally laid down the cells mature rapidly, and the last step in their cycle consists of the formation of echinulate spores. The spores develop on filaments or hyphal branches, as do conidiospores, and the carriers of these cells have been termed conidiophores. Such a terminology would place the organism in the Conidiophorales as has already been done. There is apparently no sexuality here. The confusion, however, is due to the fact that the resulting spores appear to be formed in a manner which would take them from the above group, the Fungi Imperfecti, and place them in a better-known division of fungi, the Ascomycetes. This change is subject to the further investigation of the organism.

Vuillemin observed a thickening and granulation of the external spore wall which makes the spore appear dark. Here, the dark echinulate spore develops from within the cell (pl. 10, fig. 65). When mounted in a lacto-phenol preparation or some aniline dye, the internal cytoplasm appears as a much-thickened and darker-staining material surrounded by a faintly staining cell wall. As the spore matures it becomes thicker, showing small striations which at first appear as deep corrugations, and later developing fine prickles. In the meantime the cell wall degenerates, becomes irregular, loses its consistency and finally is devoid of life. At this time it is a disintegrating brownish material (pl. 10, fig. 74). The fine prickles are now more apparent and finally develop into small spines. At times the hemispores may sporulate simultaneously (pl. 9, fig. 26), so that two spores may appear attached (pl. 10, fig. 66). However, the usual procedure consists of the dispersal and production of these structures at the apex and proceeding down towards the base of the hypha. The type of spore development is highly suggestive of uni-spored asci and the hypha may then be called ascogenous. Further evidence will be derived from

cytological investigations now in progress. In coremia the developing spores simulate roses in a bouquet, and the whole structure, superficially, appears like that found in *Briosia* of the Phaeostilbaceae of the Fungi Imperfecti.

CULTURAL DESCRIPTIONS

The organism presented a yeast-like appearance at first, but after repeated subculturing and storage in the ice-box, the morphology was changed. This suggested an adaptation to a saprophytic mode of life, and consequently it was decided to grow the microbe in a number of different media. These substrates form a general list commonly employed in examination of fungi and involve a range of hydrogen-ion concentrations, different amounts of protein or protein decomposition products as peptones, and also varying amounts of carbohydrate and nitrogen.

The following media used for the description of the organism are arranged in the order of decreasing concentration of hydrogen ions. All cultures were grown at approximately 25° C.

Raulin's Agar (pH 4.1).—Colony submerged in agar and seen only by allowing a light to pass through the medium. Diameter approximately 3.5 cm. after 32 days. Chains of cells spherical to ovoid, 5–6 μ in diameter; coremia with slightly elongated cells 4 × 6 μ, and elongated cells 4–6 × 7–9 μ; long narrow hyphal cells 3 × 15 μ; large spherical cells 9 μ in diameter; chains of cells somewhat cylindrical, terminating in a spherical or ovoidal cell approximately 7 μ in diameter.

Richards' Agar (pH 4.3).—Colony submerged as above, showing the branched growth with a diameter of approximately 3.5 cm. after 32 days. Cells in chains, spherical to ovoid, 6–8 μ in diameter; cylindrical cells in series, 4 × 9 μ, thick-walled or double-contoured; many young filaments tapering off from a series of yeast-like cells, to longer finer cells of a smaller diameter, 2–3 μ; filaments of cells with the ultimate structure thick-walled, enlarged, and showing a cross-wall to form 2 hemispherical cells.

Czapek's Agar (pH 4.4).—Colony as above, diameter 4 cm. after 32 days. Chains of cells; round cells 4–8 μ; elongated

ovoid cells 3–4 × 7–9 μ, arthrosporous; series of subclavate cells with ultimate cell approximately 6 μ in diameter.

Wort Agar (Product of Digestive Ferments Co., pH 4.8).—Colony vermiculate, heaped up, light cinnamon in color, approximately 2 cm. in diameter after 32 days. Growth mucoid, thick and tenacious. Many large yeast-like cells 6–8 μ in diameter, with a thick gelatinous or mucilaginous sheath enlarging the cell diameter to 8–15 μ; coremia of bundles of chains of cells 3–4.5 μ in diameter, 7–21 μ in length. Gelatin-encased cells borne at tips of filaments in short chains, developing from hemispores or partitioned-off cells by a process simulating arthrospore formation. Blastospores approximately 6 μ in diameter; large spherical thick-walled cells (intercalary) approximately 10 μ in diameter; ovoid cells 8–9 × 12–14 μ; echinulate spores approximately 5 μ in diameter.

Malt Extract Agar (pH 5.2).—Colony vermiculate at periphery and center with radiate creamy-buff to yellow ridges. Culture heaped up at center, point of inoculation approximately 3 cm. in diameter after 32 days. Chains of spherical cells approximately 10 μ in diameter. Mucoid secretion present, but not in such great abundance as above. Characters otherwise similar to those on wort agar.

Sabouraud's Agar (pH 5.6).—Colony cerebriform at point of inoculation with a coremiform, vermiculate ring of growth a short distance from the center, merging into a flat growth. Color that of medium, creamy-buff to amber. Diameter approximately 5 cm. after 29 days. Coremia of chains of cells 3–4 × 8–20 μ; elongate blastospores 4 × 6 μ, spherical 5 μ in diameter; large clavate cells terminal on filaments; elongated unicellular filaments and sclerotic cells 3 μ in diameter; many budding spherical cells approximately 6 μ in diameter; echinulate dark spores approximately 5 μ in diameter.

Sabouraud's Broth (The above minus the agar).—Organism in flakes and groups of cells at bottom of flask. Chains of cells as above; no coremia; spherical cells 4–15 μ in diameter; arthrosporous cells 4 × 6 μ; hyphae of long cells 4 × 30 μ; echinulate spores approximately 5 μ in diameter.

Corn-Meal Agar (Product of Digestive Ferments Co., pH

6.0).—Growth similar to that on Richards' agar except for a finely visible surface formation. Colony approximately 3.5 cm. in diameter after 32 days, color light Isabella. Thick-walled spherical cells in chains, 8–10 μ in diameter; arthrosporous cells 4–6 × 6–10 μ, many cells of varying dimensions; hemisporous clavate cells 7–10 × 15–18 μ; hyphae 3–4 μ in diameter.

Potato-Dextrose Agar (pH 6.2).—Colony 6 cm. in diameter after 32 days, with many radiate branched cerebriform striations or grooves from a highly peaked center. Color creamy-buff. Coremia present; hyphae 3–4 μ in diameter; chains of spherical cells 5–6 μ in diameter, and arthrosporous cells 4 × 6–8 μ; large cells 12–17 μ in diameter; clavate triseptate cells 12–15 × 15–18 μ; hemisporous clavate cells 9 × 15 μ; elongated cells 4–6 × 6–15 μ, in chains; citriform to subovoid cells 4–6 × 6–8 μ; sclerotic cells numerous, as well as racquet or clavate cells in short chains.

Lactose Broth (Product of Digestive Ferments Co., pH 6.8). —Macroscopic appearance similar to that in Sabouraud's broth. Chains of spherical cells 5–6 μ in diameter, occurring terminally on filaments. Cells catenulate, simulating those found in *Oospora;* hyphae approximately 3 μ in diameter; spherical terminal cells 9 μ in diameter; clavate hemisporous cells 7 × 12 μ; conidium-like cells 6–9 μ in diameter, somewhat pyriform to ovoid; intercalary spherical cells 6–8 μ in diameter.

Lactose Agar (The above plus 2 per cent agar).—Colony raised and convolute in center, with radiate striations to periphery, approximately 5 cm. in diameter after 32 days. Cells in chains as in broth; fine coremia appearing hyaline to white on surface, consisting of spherical, subovoid and arthrosporous cells; hyphae 3 μ in diameter; echinulate spores approximately 5 μ in diameter, appearing black with lacto-phenol (cotton blue).

Nutrient Agar (Product of Digestive Ferments Co., pH 7.0). —Colony flat except for a slightly raised center, approximately 4 cm. in diameter after 32 days. Culture appears asteroid or stellate, color that of medium. Hyphae 4 μ in diameter; terminal spherical cells approximately 6 μ in diameter; terminal clavate hemisporous cells and intercalary spherical cells; large

spherical cells 10–12 μ in diameter; cells in chains, 6–8 μ in diameter. General characteristics similar to those on lactose agar.

Glycerine Agar (Nutrient agar plus 6 per cent glycerine, pH 7.0).—Cultural appearance similar to that on potato-dextrose agar. Very fine prickles on surface of colony, coremia. Colony approximately 4 cm. in diameter after 32 days. Color creamy-buff, with a hyaline sheen. Hyphae 3–4 μ in diameter; many large multi-septate filaments 5–7 μ in diameter; conidium-like cells approximately 5 μ in diameter; clavate cells, di- and tri-septate, 9–12 μ in diameter; large cells 9 μ in diameter; small spherical cells 4–7 μ in diameter; cells of filaments 4 × 12 μ; arthrosporous cells 4 × 8–9 μ. Many clumps of cells 6–7 μ in diameter held by a gelatinous matrix; clavate hemisporous cells 9 × 12–15 μ.

Serum Agar (Nutrient agar plus 1 per cent bacto-beef blood serum, pH 7.2).—Colony macroscopically simulates that on nutrient agar except for the greater number of radiations or ridges. Diameter approximately 3 cm. after 32 days. Color creamy-buff to amber. Cells of filaments approximately 6 μ in diameter; terminal cells 7–8 μ in diameter; hyphae 3–4 μ in diameter; ovoid cells 4 × 7–8 μ; many small spherical cells approximately 4 μ in diameter. Cells in general seem to be in a simple yeast condition due perhaps to the serum in the medium.

Endo's Agar (Product of Digestive Ferments Co., pH 7.5).—Culture macroscopically similar to that on glycerine except that here the mycelium has taken up the red dye of the medium. Diameter approximately 3.5 cm. after 32 days. Characters similar to those on Sabouraud's agar.

Gelatine (Beef extract broth plus 10 per cent bacto gelatine).—Liquefaction starts on twelfth day at surface and proceeds downward.

Litmus Milk.—Acid and curdling start on the third day and are complete on the seventeenth day.

Carbohydrate Reactions.—Acid and no gas production with l-arabinose, l-xylose, glucose, galactose, d-mannose, levulose, lactose, maltose. No acid or gas, but an alkaline reaction with rhamnose, saccharose, raffinose, amygdalin, and salicin.

DISCUSSION

The genus *Hemispora* was created by Vuillemin in 1906, with a single species *stellata*, so called because of the presence of star-like growths on *Aspergillus repens.* The surface of the organism was powdery and the whole growth was brown in color. On microscopic examination, the powder or dust was found to be a mass of spores. The microbe was later found in a number of conditions existing as a saprophyte. As a parasite the fungus or a closely related organism has been isolated from a number of cases which resembled clinically sporotrichosis, and the cultivation of the microbe was required in order to arrive at a better diagnosis.

On the basis of the type of spore formation, that is, the production of branches of hyphae which have at their apex a large cell termed a protoconidium or hemispore, the fungus was classified with the Conidiophorales. The protoconidia give rise almost simultaneously to cells which approximate each other in size and are termed deuteroconidia.

Several years after Vuillemin's classification and identification of *Hemispora stellata,* Castellani in 1910 isolated a new species, *H. rugosa,* from cases of bronchitis and a case of tonsillitis. This organism differs from the former in the type of cultural growth, which is abundant on glucose agar, crinkled, and at times cerebriform. The color varies from amber to brown. The main difference, according to Vuillemin, seems to be that it grows in gelatine and liquefies it slowly, while gelatine liquefaction is negative with *H. stellata.* Milk is not changed generally, but may be somewhat peptonized with a small coagulum. The sugar reactions are as follows: acid with saccharose, glucose, arabinose and levulose, and doubtful for maltose; no acid with lactose, dulcite, mannite, dextrin, raffinose, adonite, inulin, starch, salicin, galactose, and glycerine. Litmus milk is negative.

A third species, *H. pararugosa* Castellani, Douglas and Thompson, mentioned by Castellani ('25), differs from *H. rugosa* in being a rapid liquefier of gelatine. This organism may be only a variety of the former, or perhaps identical with

that species. It is generally recognized, however, that both species are unlike *H. stellata,* and Ciferri and Redaelli ('34), in a foot-note, make the following statement: "*Hemispora rugosa* Cast. and *H. pararugosa* Cast., Douglas and Thompson, are *Trichosporon- (Trichosporum-)* like fungi, in no way comparable to *Hemispora stellata,* in spite of the strange affirmation of Vuillemin (1931) that the differences pending [sic] on the liquefaction of gelatine."

These two authors in the same paper, which is a summary of a paper dealing with a comparative study of twenty-one strains of fungi referred to as *H. stellata* Vuill., *Oospora d'Agatae* Sacc., *Torula sacchari* Corda, etc., place the genus *Hemispora* in synonymy with the genus *Sporendonema* of Desmazières (1827). Although the type species of the latter genus should be *S. casei* (Desmazières, 1827), they create a new combination with the species *Torula epizoa* Corda, *Sporendonema epizoum* (Corda) Ciferri and Redaelli, and establish that as the type species.

In spite of the elaborate description and combination by these two authors, it seems that the interpretation of previously existing genera is almost purely personal. On the other hand, it is difficult to compare favorably the generic characters based entirely on morphologic features with the structures existing in Vuillemin's *Hemispora.* It is very easy to assume similarities, but genera cannot be based entirely on assumptions especially if the diagnostic features are lacking. The author is satisfied that the genus *Sporendonema* shows insufficient similarity in characteristics to replace *Hemispora.* Further, there is no apparent certainty that the fungus originally described by Vuillemin was the one which these or other authors have been able to obtain for comparison. In addition, because of the type of spore production which suggests itself as ascogenous, the genus *Hemispora* should stand, with a position in the Ascomycetes.

In this regard, the organism described in this paper simulates closely characters attributed to *H. stellata.* After carefully comparing these characters with those of the monotypic

genus, *Hemispora*, it appears to the author that the fungus described in this paper has several differences which require for it a separate classification as a new species.

Hemispora coremiformis Moore, n. sp.

Growth in host of yeast-like cells 4–6 μ in diameter. On artificial media cultures show abundant mycelium of branching septate hyphae 2–4 μ in diameter, terminating in clavate, spherical or ampulliform cells (hemispores) 7–15 × 12–18 μ. Sexuality absent. Coremia formed on most solid media. Cultures stellate, vermiculate, coremiform, or cerebriform; color grayish-white, creamy-buff, light cinnamon, light Isabella. Cells of coremia 3–6 × 5–21 μ; large spherical cells 6–17 μ in diameter; conidia 4–6 μ in diameter; blastospores 4–6 μ (spherical), 4 × 6 μ (pyriform); spherical intercalary chlamydospores 6–10 μ in diameter, ovoid 8–9 × 12–14 μ. Echinulate spores resulting from apical cells of mature filaments 3–6 μ in diameter, in general 5 μ. Acid and no gas with l-arabinose, l-xylose, glucose, galactose, d-mannose, levulose, lactose, maltose. No acid or gas with rhamnose, saccharose, raffinose, amygdalin, salicin. Gelatine liquefies slowly, starting on the twelfth day. Litmus milk becomes acid and curdles starting on the third day, complete on the seventeenth day.

Hemispora coremiformis Moore, n. sp.

Mycelium in culturis abundans sed in hospite cellulae singulae diametro 4–6 μ sunt. Hyphae ramulosae septataeque, diametro 2–4 μ, cellulae terminales clavatae, sphericae vel ampulliformes (hemisporae) 7–15 × 12–18 μ. Sexus deest. Coremia in mediis solidiis. Culturae stellatae, vermiculatae, coremiformes cerebriformesve; color albidus, subalutaceus, dilute cinnamomeus vel dilute isabellinus. Cellulae coremiae 3–6 × 21 μ; conidia diametro 4–6 μ, blastosporae pyriformes, 4 × 6 μ; chlamydosporae, sphericae intercalarae diametro 6–10 μ, ovoideae 8–9 × 12–14 μ. Sporae echinulatae ex cellulis apicalibus hypharum maturarum diametro 3–6 μ generatim diametro 5 μ. Acidus in saccharo; "l-arabinose, l-xylose, glucose, galactose, d-mannose, levulose, lactose, maltose." Fermentatio nulla in saccharo; "rhamnose, saccharose, raffinose, amygdalin,

salicin." Gelatinum per duodecim diebus fluidificans. Lac concretus, acidum per tribus diebus absolute per septendecim diebus faciens.

SUMMARY AND CONCLUSIONS

1. A brief historical review of hemisporosis is given, with an abstract of an infection of the head occurring on a man in Costa Rica.
2. The organism exists as a yeast-like organism in the host and changes to a filamentous fungus on artificial media.
3. The microbe is characterized by the formation of coremia on most solid media, not on liquid media.
4. The mycelium consists of arthrosporoid cells, elongated forms and short structures which occur either as simple or branched filaments. These hyphae usually terminate in spherical or clavate cells, the protoconidia, which later divide to form deuteroconidia and develop echinulate spores.
5. The organism is described on several media, culturally and microscopically.
6. Gelatine is liquefied starting on the twelfth day.
7. Litmus milk is acidified and curdled starting the third day and completed on the seventeenth day.
8. Acid and no gas with 1-arabinose, 1-xylose, glucose, galactose, d-mannose, levulose, lactose, maltose. No acid or gas with rhamnose, saccharose, raffinose, amygdalin, and salicin.
9. As a result of the characteristics and properties of the organism, it is described as a new species of *Hemispora*, *H. coremiformis*.

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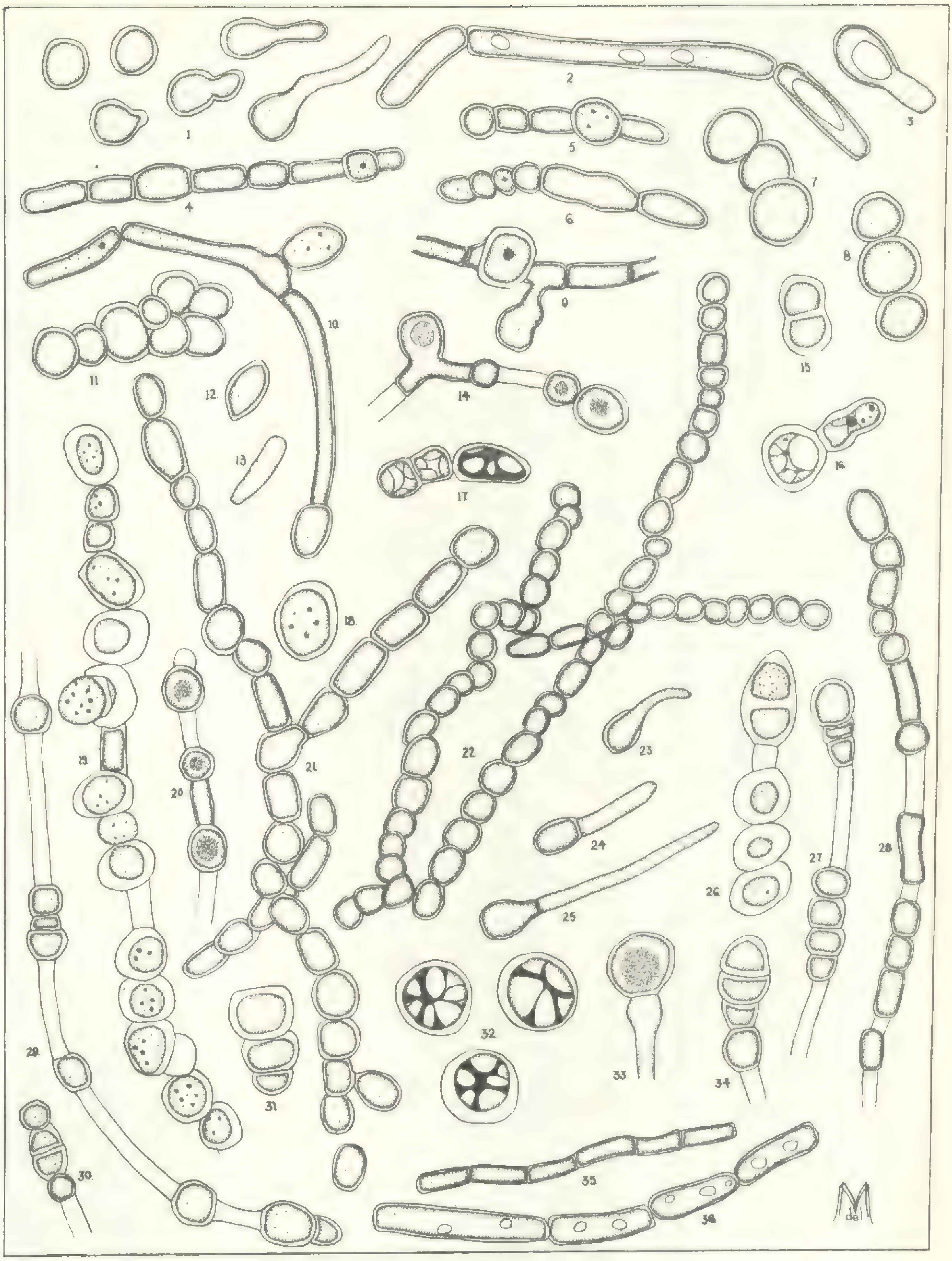
Explanation of Plate

PLATE 9

Hemispora coremiformis

All figures drawn with the aid of a camera lucida at a magnification of × 1440 and reduced to approximately × 750.

Fig. 1. Group of yeast-like cells, first subculture on Sabouraud's agar.
Fig. 2. Filament in Sabouraud's broth.
Fig. 3. Germinating spore on Raulin's agar.
Fig. 4. Filament with chlamydospore on Raulin's agar.
Fig. 5. Filament with chlamydospore on Richards' agar.
Figs. 6–7. Type of cells on Raulin's agar.
Fig. 8. Oidia-like cells in Sabouraud's broth.
Fig. 9. Mycelium with chlamydospore and conidium on lactose agar.
Fig. 10. Hypha showing blastospores on Sabouraud's agar.
Fig. 11. Oidia-like cells on malt-extract agar.
Figs. 12–13. Types of cells on Raulin's agar.
Fig. 14. Type of mycelium in lactose broth.
Figs. 15–16. Hemispores on corn-meal agar.
Fig. 17. Cells mounted in lacto-phenol as fig. 16 from glycerine agar.
Fig. 18. Thick-walled spherical cell in Sabouraud's broth.
Fig. 19. Filament showing gelatinous secreted cells on wort agar.
Fig. 20. Mycelium on potato-dextrose agar.
Fig. 21. Mycelium on Richards' agar.
Fig. 22. Smaller cells as seen on Raulin's agar.
Figs. 23–25. Germinating conidia on Sabouraud's agar.
Fig. 26. Cells on malt-extract agar, showing a terminal hemispore heavily encased.
Fig. 27. Oidia-like cells separated by clear cells in lactose broth.
Fig. 28. Type of mycelium on Czapek's agar.
Fig. 29. Mycelium as fig. 27.
Fig. 30. Terminal cell condition of a filament on serum agar.
Fig. 31. Deuteroconidia formed on potato-dextrose agar.
Fig. 32. Group of spherical cells mounted in lacto-phenol from Sabouraud's agar.
Fig. 33. Terminal spherical cell on lactose agar.
Fig. 34. Terminal deuteroconidial condition on lactose agar.
Fig. 35. Hypha on glycerine agar.
Fig. 36. Hypha in Sabouraud's broth.



MOORE—HEMISPORA COREMIFORMIS

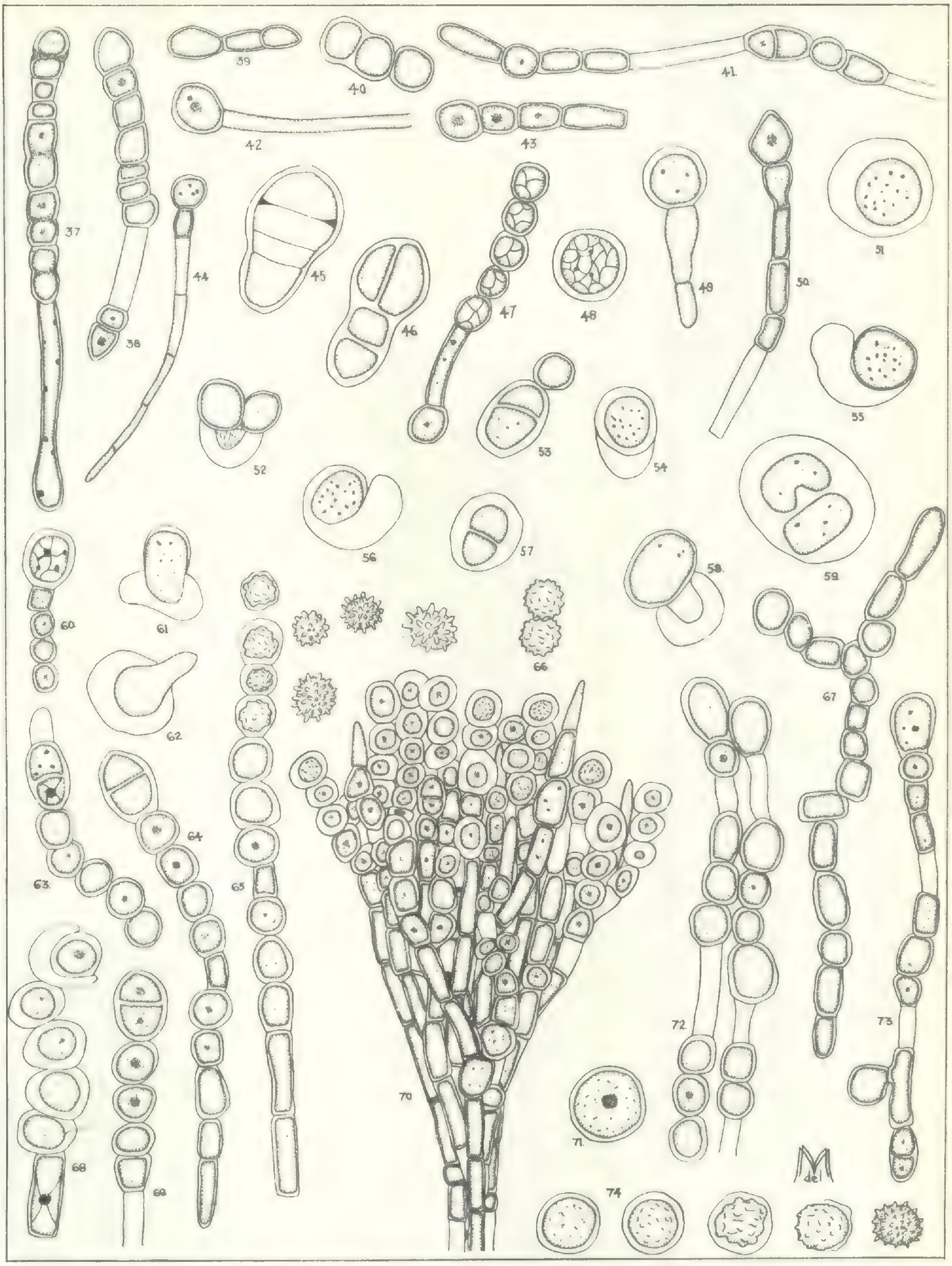
Explanation of Plate

PLATE 10

Hemispora coremiformis

All figures drawn with the ai dof a camera lucida at a magnification of × 1440 and reduced to approximately × 750, except fig. 70, which was drawn at × 960 and reduced to × 510.

Fig. 37. Cross-wall formation in hypha in lactose broth.
Fig. 38. Mycelium on serum agar.
Fig. 39. Cells on Richards' agar.
Fig. 40. Hemispore on malt-extract agar.
Fig. 41. Mycelium on Richards' agar.
Fig. 42. Terminal spherical cell on potato-dextrose agar.
Fig. 43. Terminal cells on Raulin's agar.
Fig. 44. Young filament showing tapering of cells from a terminal spherical cell.
Figs. 45–46. Ampulliform cells on potato-dextrose agar.
Fig. 47. Deuteroconidial cells in Sabouraud's broth.
Fig. 48. Spherical cell in Sabouraud's broth mounted in lacto-phenol.
Fig. 49. Terminal spherical cell on malt-extract agar.
Fig. 50. Filament showing terminal cell condition on Raulin's agar.
Figs. 51–52, 54–59, 61–62, 68, 70. Cells on wort agar showing gelatinous secretion. Fig. 70 shows a coremium.
Fig. 53. Hemisporous condition on corn-meal agar.
Fig. 60. Terminal cells on Richards' agar.
Figs. 63–64. Mycelium showing terminal hemisporous condition on Richards' agar.
Fig. 65. Filament on malt-extract agar showing formation of echinulate spores from apical end.
Fig. 66. Adjoining echinulate spores formed from a hemispore on wort.
Fig. 67. Mycelium on Czapek's agar.
Fig. 69. Terminal cell condition on malt-extract agar.
Fig. 71. Spherical cell on Richards' agar.
Fig. 72. Filaments from a coremium on potato-dextrose agar.
Fig. 73. Mycelium on Czapek's agar.
Fig. 74. Series showing development of echinulate spore.



MOORE—HEMISPORA COREMIFORMIS

A MORPHOLOGICAL AND PHYSIOLOGICAL STUDY OF TWO SPECIES OF POSADASIA

P. CAPSULATA (DARLING) MOORE AND P. PYRIFORMIS MOORE

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INTRODUCTION

The etiological agent of histoplasmosis has for a number of years been incorrectly determined. The disease, made well-known in a series of papers by the original describer of the infection, Darling ('06, '08, '09), was attributed to a protozoon. Later investigators considered it a *Cryptococcus* (da Rocha-Lima, '12, '13; Castellani and Chalmers, '19; Vuillemin, '31) or an *Oidium*. This confusion may have been due to the inability of the earlier workers to grow the organism, all systematic classification being based on smears or tissue sections. The present author, upon receipt of an organism from a proven case of histoplasmosis, sought to determine the correct position of the fungus.

The disease itself is a serious and apparently fatal infectious condition which is present in America and resembles kala-azar of India and Tropical America. It is characterized clinically by emaciation, severe anemia, with a marked leucopenia, splenomegaly, enlargement of the liver, and irregular pyrexia. Pathologically, the organism is found to invade the endothelial cells in the smaller lymph and blood vessels and capillaries. The affected organs become necrosed and the liver develops cirrhosis. The lungs and small and large intestines are studded with pseudotubercles, giving the appearance of miliary tuberculosis. The peribronchial lymph nodes usually are enlarged, showing some tubercles most of which become ulcerated.

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The first case that came under Darling's observation was that of a negro, a native of Martinique, 27 years of age, who was mildly delirious and incoherent in his speech. The patient showed an enlarged spleen. The autopsy picture was typical of what has been pointed out previously. The second case was also that of a Martiniquan negro. The third case was a Chinese shopkeeper, who had lived on or near the Isthmus of Panama for 15 years.

The organism of *Posadasia capsulata*, studied in this paper, was received from Charles Thom, Principal Mycologist of the United States Department of Agriculture. It had been sent to him by DeMonbreun of Vanderbilt University, who isolated it from a case of histoplasmosis, described by Dodd and Tompkins ('34). DeMonbreun ('34) apparently proved the pathogenicity of the organism by carrying it through experimental animals and recovering the pathogen. Dodd and Tompkins ('33) and DeMonbreun ('33) reported their findings at the meeting of the Society for Tropical Medicine at Richmond, Virginia, November 15, 1933.

The second organism, *P. pyriformis*, was received from G. H. Hansmann, formerly of Iowa City and now of Georgetown University School of Medicine. Hansmann and Schenken ('33) had reported a case before the American Association of Pathologists and Bacteriologists at their Washington meeting on May 9, 1933. The patient was a white male, 43 years old at time of death. He had had a refractory skin ailment for the last 16 years of his life. This was a scaly inflammation underneath which the skin was thick and red, becoming more intense during 1929. In June of 1932 the skin showed hard nodules, and in July the patient developed a high fever, signs of pleurisy, and died on August 7. The microbe was cultured from dermal elevated spots and an enlarged lymph node. The fungus was considered an *Oidium*.

TECHNIQUE

Hanging-drop, water mounts, and also simple water mounts on a slide revealed the general outline of the organism clearly. Mounts made with Amann's lacto-phenol also gave favorable

results, but those in crystal violet in glycerine were only fair. The mycelium of these fungi is such that only the large cells and the asci show any indication of cellular construction. The hyphae are fairly small, and the details are obscured by the wall, which is quite thick here.

In order to trace the development of a single ascus, beef-extract gelatine mounts were made with a suspension of mycelium, gelatine being used in place of agar because of its greater transparency. Many of the cell interpretations are based on a study of sectioned materials.

Description

The life cycles of yeast-like fungi are usually complicated, because different habitats change the type of growth. In many cases, a different mycelium is linked with the loss of infectivity, or the change from a parasitic to a saprophytic mode of life. In any case, the organisms involved here existed as simple yeast-like cells, spherical or ovoid, varying from 1 to 4 μ in long axis, usually 3 μ. According to Darling, these cells are surrounded by a clear refractile and non-staining rim which equals in thickness about one-sixth the total diameter of the cell. The structure of these cells is found to be non-homogeneous, having a granular protoplasm which may be vacuolated. These cells multiply by elongation and fission according to da Rocha-Lima ('12, '13), which led him to consider these fungi as members of the genus *Cryptococcus*.

When transferred to an artificial substrate, the organism changes to a mycelial growth with aerial and submerged hyphae. When kept in blood and serum cultures at 37° C., however, and transferred at short intervals the yeast-like form persists or predominates, according to observations by DeMonbreun ('34) and also by Thom. All studies made here are from cultures which had already formed mycelium, having no evidence of yeast-like cells.

The filamentation consists of multi-celled hyphae 1–5 μ in diameter, with various types of morphology (pls. 11–14). There finally results a tubercled ascus containing a number of small spores. The yeast-like cells thus undergo a state of

elongation which gives them a sclerotic appearance, to form filaments.

To describe the later development of the fungus on an artificial substrate, it seems best to start with the ascospore which supposedly is the germ of the colony. These spores (pl. 11, fig. 1; pl. 13, fig. 72) are small, and when set free from the ascus germinate to form a mycelium such as is shown in the illustrations. The hyphae are multi-celled and, from indications of cytological work in progress, coenocytic. These cells may be elongated and narrow (pl. 11, fig. 2) or short and thick, usually depending on the type of medium. The filaments may develop peculiar swellings (pl. 11, figs. 32, 38, 42; pl. 12, fig. 55; pl. 13, figs. 75, 82, 90), or they may give rise to the well-known racquet mycelium (pl. 11, figs. 4, 8, 16–17; pl. 13, figs. 77, 97). The hyphae may further be distorted and present peculiar types of development (pl. 11, figs. 40, 47; pl. 13, fig. 101).

In addition, there are a number of types of cells which play an important rôle both in propagation and conservation of the organism. These organs include chlamydospores, conidia, and asci. The chlamydospores vary in size and proportions in *Posadasia capsulata* and *P. pyriformis.* They may be intercalary, 3–10 μ in diameter, and may occur singly (pl. 11, fig. 23) or in groups or chains (pl. 13, fig. 96) and may also be found laterally (pl. 11, fig. 30; pl. 12, fig. 64; pl. 14, fig. 109), sessile or pedicellate. They may also occur terminally as enlarged forms, 3–10 × 6–20 μ. On serum agar in the moist region of the colony are series of cells (pl. 13, fig. 95) which simulate chlamydospores but are actually yeast-like.

Conidia are cells of great importance in propagation. They occur laterally, are sessile or pedicellate, spherical or pyriform, 2–8 μ in diameter (pl. 11, figs. 23, 28; pl. 12, figs. 60, 64). They are present on most media, especially on substrates with a low pH. On serum agar in *P. capsulata* they are found at just above or just under the surface, while in *P. pyriformis* they are mostly above the surface. Conidia break off easily from the hyphae and germinate (pl. 11, fig. 1; pl. 13, fig. 72) to give rise to a new colony serving much the same purpose as do the ascospores.

In all the observations of the microbes presented here, no indication of sexuality has made itself evident. Instead, the non-sexual ascus develops terminally, laterally, or as an intercalary organ. Asci form first as globose or clavate cells on short or long pedicels or on one- to several-celled filaments. These cells enlarge and may become 5–18 μ in diameter or in long axis. The pedicels may be perpendicular to the hyphae (pl. 14, figs. 106–107). The presumptive asci have thick walls (pl. 11, figs. 35–36; pl. 12, fig. 53) and when placed in a water mount show numerous oil globules, representing a large food-storage supply. In *P. capsulata* these cells are spherical or become so to form the spherical ascus typical of the species, while in *P. pyriformis* they may be spherical or pyriform. When young the presumptive asci are smooth-surfaced and thick-walled. As they grow older those present at or on the surface of the medium become somewhat pitted, then spinose (pl. 12, figs. 56, 65; pl. 14, figs. 113–115), while those below the surface or submerged in the agar remain smooth. The spines develop into variously shaped tubercles in the adult ascus. In the case of *P. capsulata,* on some of the substrates there are more asci at or on the surface than within the medium, whereas in *P. pyriformis* these cells form a heavy and deep layer on the surface with smaller smooth forms just below the surface.

The tubercles of the asci, mentioned above, vary in number and size and may become long finger-like projections simulating germ-tubes (pl. 12, fig. 66). These may also be spherical emergences (pl. 11, fig. 51; pl. 12, figs. 58, 67; pl. 14, fig. 122) or short blunt outgrowths (pl. 12, figs. 62–63, 68–70), or they may be situated almost diametrically opposite as large blunt membranous growths (pl. 12, figs. 57, 61). In most cases, however, there are combinations of nearly all types, particularly long and short tubercles. These are comparatively smaller on the pyriform asci in *P. pyriformis* (pl. 14, figs. 118, 125, 130). The so-called germ-tubes may vary from approximately .5 to 7 μ in the adult ascus. The asci themselves, exclusive of the tubercles, vary in size in both species. The spherical forms vary from 5 to 25 μ in diameter, while the pyriform asci, present only in *P. pyriformis,* are 6–12 × 12–26 μ, usually 10 × 22 μ.

Cytological investigations show that the single ascus contains a number of spherical spores which are set free by a rupture of the ascus wall to germinate and commence another cycle. When in a nutrient condition the ascus may germinate with few to several germ-tubes which develop into a mycelium (pl. 12, fig. 71). Apparently, the tubercles play no part in reproduction or propagation, for a study of their structure shows them to be clear and void of any protoplasm.

CULTURAL DESCRIPTIONS

The cultures obtained were transferred to Sabouraud's glucose agar. Since, as previously emphasized, a study of an organism should not be limited to a single substrate, a number of standard media were inoculated and grown at room temperature, approximately 22° C. It was desirable to make a comparative study of both organisms, and like media were therefore seeded with the two species. The following artificial substrates are arranged in the order of their decreasing hydrogen-ion concentration.

POSADASIA CAPSULATA

Raulin's Agar (pH 4.1).—Growth poor, diameter approximately 2 cm. after 43 days. Colony white and cottony. Mycelium variable in size and shape; hyphae 2–3 μ in diameter, with intercalary chlamydospores approximately 10 μ in diameter; racquet mycelium; terminal hypnospores 9 × 18 μ; large round cells at end of a thin filament approximately 10 μ in diameter; conidia 3–5 μ in diameter; tuberculate asci lacking.

Richards' Agar (pH 4.3).—Colony approximately 2.5 cm. in diameter after 43 days. Point of inoculation somewhat heaped up, white and cottony. Mycelium mostly submerged in the agar. Culture consists chiefly of long branching hyphae 2–3 μ in diameter; many small round cells approximately 3 μ in diameter, large round cells terminal on long thin filaments, 5–10 μ in diameter; conidia ovoid or pyriform, 5 μ in diameter; intercalary chlamydospores 5–10 μ in diameter, terminal hypnospores as above; racquet mycelium present; asci with tubercles not apparent.

Czapek's Agar (pH 4.4).—Colony approximately 3 cm. in diameter after 43 days. Growth loose and cottony, color white. Mycelium similar to that found on the above two media.

Malt Extract Agar (Product of Digestive Ferments Co., pH 4.6).—Colony approximately 4.2 cm. in diameter after 43 days. Development of ridges from point of inoculation to woolly periphery. Color light Isabella. Abundant mycelium of hyphae 2–3 μ in diameter; racquet mycelium; conidia 3–5 μ in diameter, spherical on short pedicels, or pyriform; intercalary chlamydospores 5–8 μ in diameter, singly or in chains; terminal clavate and elongate cells varying in size and shape with the age of the organism; many small round cells approximately 3 μ in diameter, probably conidia; asci numerous, tuberculate, 15–20 μ; round cells on long thin filaments, approximately 1.5 μ in diameter, probably young asci.

Wort Agar (Product of Digestive Ferments Co., pH 4.8).—Colony approximately 3 cm. in diameter after 43 days. Growth thick and cottony. Color light Isabella. Racquet mycelium abundant, with hyphae approximately 3 μ in diameter; intercalary chlamydospores 5–8 μ in diameter; terminal spherical cells 5–10 μ in diameter; conidia numerous, 5 μ in diameter; many asci 10–20 μ with tubercles or club-like projections up to approximately 7 μ in length.

Sabouraud's Agar (pH 5.6).—Colony approximately 4.7 cm. in diameter after 43 days. Growth cottony, showing clumps similar to pleomorphic changes found in cultures of dermatophytes, color light Isabella. Hyphae 2–3 μ in diameter; conidia 3–5 μ in diameter, mostly spherical; intercalary chlamydospores spherical, 5–7 μ in diameter; racquet mycelium present; asci numerous, 15–18 μ in diameter, with many tubercles projecting from the surface of the ascus.

Sabouraud's Broth (The above minus the agar, pH 5.6).—Growth of flakes or clumps, chiefly at bottom of flask. Surface shows a folded growth, cottony, with upright hyphae on surface macroscopically similar to columellae. Mycelium on surface white to light Isabella in color, similar to that found on agar. Broth becoming dark with growth of organism. Submerged growth of long branching hyphae 1.5–2 μ in diameter.

Clavate cells terminal on filaments, varying in proportion and size.

Corn-Meal Agar (Product of Digestive Ferments Co., pH 6.0).—Colony cottony, slightly heavy at point of inoculation, white in color, with a diameter of approximately 1.5 cm. after 43 days. Hyphae 2–3 μ in diameter, showing many swellings; racquet mycelium very much enlarged; conidia thick-walled, approximately 5 μ in diameter; intercalary chlamydospores approximately 8 μ in diameter; terminal hypnospores also present; terminal clavate cells approximately 10 μ in diameter; asci 10–15 μ in diameter.

Potato-Dextrose Agar (pH 6.2).—Colony very much heaped-up in center, cottony, white to light Isabella in color, 3 cm. in diameter after 43 days. Cells larger than on the above media. Hyphae 3–4 μ in diameter, some larger; racquet mycelium very characteristic, swollen portions much enlarged; conidia 5–7 μ in diameter; intercalary chlamydospores 8–10 μ in diameter, spherical lateral forms on 2- or 3-celled pedicels, 6 μ in diameter, many occurring singly as well as in chains; clavate sessile cells; asci larger than others, up to 25 μ in diameter.

Lactose Broth (Product of Digestive Ferments Co., pH 6.8).—Flakes of cottony growth submerged in the medium with surface growth. Mycelium of long branching hyphae approximately 2 μ in diameter; very few swollen cells or racquet formation; very few conidia; terminal clavate cells present; tuberculate asci absent in submerged mycelium. Aerial growth similar to that found on an agar substrate of the same constituents.

Lactose Agar (The above plus 2 per cent agar).—Colony cottony, white to light Isabella in color, showing radiating ridges from the inoculum, attaining a diameter of approximately 3 cm. after 43 days. Hyphae small, many 1–1.5 μ in diameter, some 2–3 μ; conidia numerous, 3–5 μ in diameter; racquet mycelium present; intercalary chlamydospores 5–8 μ in diameter; asci approximately 15 μ in diameter.

Nutrient Agar (Product of Digestive Ferments Co., pH 7.0).—Growth fair, colony sparsely cottony, somewhat flat, with a diameter of approximately 2.8 cm. after 43 days. Color light Isabella. Hyphae 2–3 μ in diameter; conidia sessile and pedi-

cellate, approximately 5 μ in diameter; racquet mycelium present; clavate terminal cells and intercalary chlamydospores as on lactose agar; asci as large as 22 μ in diameter with tubercles.

Glycerine Agar (Beef-extract agar plus 6 per cent glycerine, pH 7.2).—Thick cottony growth with an elevated inoculum approximately 2.5 cm. in diameter after 43 days. Color light Isabella. Hyphae 2–3 μ in diameter; sclerotic cells present; many conidia, spherical and pyriform, 3–5 μ in diameter; terminal clavate cells, spherical cells on long thin filaments, 5–10 μ in diameter; chlamydospores 5–8 μ in diameter; asci approximately 15 μ in diameter; many hyphal swellings.

Serum Agar (Bacto-beef blood serum, product of Digestive Ferments Co., plus 2 per cent agar, pH 7.3).—Colony approximately 2.5 cm. in diameter after 43 days, with deep radiating ridges from a somewhat white cottony point of inoculation to a moist and flat periphery. Hyphae tend to be thick and heavier and appear coremioid. Mycelium generally thicker, with the various cells present; conidia spherical and pyriform, sessile or pedicellate, 5 μ in diameter; chlamydospores approximately 8 μ in diameter; many large round cells in chains; asci up to 15 μ in diameter, plus the tubercles.

Endo's Agar (Product of Digestive Ferments Co., pH 7.5).—Culture assumes the pink color from the medium, cottony in appearance, with a diameter of approximately 3 cm. after 43 days. Microscopic appearance similar to that on nutrient agar.

POSADASIA PYRIFORMIS

Raulin's Agar (pH 4.1).—Colony approximately 2 cm. after 43 days. Culture white and cottony at inoculum, submerged in the medium. Mycelium shows racquet formation with swellings; hyphae 2–3 μ in diameter; conidia sessile or pedicellate, spherical or pyriform, 5–7 μ in diameter; intercalary chlamydospores spherical or slightly elongated, 3–10 μ in diameter; clavate or spherical cells on pedicels, 6–10 μ in diameter; asci below the agar without tubercles, above the surface multi-tuberculate, spherical 6–18 μ, pyriform 8–10 × 18–26 μ, in general 9 × 24 μ.

Richards' Agar (pH 4.3).—Colony approximately 2 cm. in diameter after 43 days. Culture cottony, white, and heaped-up at point of inoculation. Hyphae 3–4 μ in diameter; conidia approximately 5 μ in diameter; racquet mycelium present; intercalary chlamydospores 5–8 μ in diameter; clavate cells on long filaments; asci terminal on long several-celled pedicels, or lateral on short pedicels, spherical approximately 12 μ in diameter, pyriform 8–10 × 16–24 μ.

Czapek's Agar (pH 4.4).—Growth loose and cottony, approximately 4.5 cm. in diameter after 43 days. Color white. General characters similar to those on the above media. Hyphae 2–3 μ in diameter; intercalary chlamydospores 5–7 μ in diameter.

Malt Extract Agar (Product of Digestive Ferments Co., pH 4.6).—Colony approximately 3 cm. in diameter after 43 days. Culture cottony and somewhat flat with a heaped-up center and showing concentric circles of growth, Isabella color. Racquet mycelium in abundance with numerous swellings; hyphae 2–3 μ in diameter, some larger; conidia sessile or pedicellate, spherical or pyriform, 5–8 μ in diameter; intercalary chlamydospores 3–8 μ in diameter; terminal clavate cells present; asci relatively few in number, spherical predominating, approximately 12 μ in diameter.

Wort Agar (Product of Digestive Ferments Co., pH 4.8).—Growth thick and cottony, appearing cerebriform and convolute at point of inoculation. Diameter approximately 2 cm. after 43 days' growth. Color light Isabella. Racquet mycelium abundant; hyphae 2–4 μ in diameter; intercalary chlamydospores 3–8 μ in diameter; conidia as on the above medium; mycelium somewhat resembling chains of oidia, with the cells 6–8 × 7–12 μ; spherical asci predominating, approximately 12 μ in diameter.

Sabouraud's Agar (pH 5.6).—Growth thick and cottony, approximately 6 cm. in diameter after 43 days. Colony Isabella-colored in center, approximately 1 cm. high, with a concentric ridge surrounded by a lighter woolly periphery. Hyphae 2–4 μ in diameter; racquet mycelium present; intercalary

chlamydospores 3–5 μ in diameter; conidia approximately 5 μ in diameter, both spherical and pyriform; asci numerous, on surface of agar, spherical 6–22 μ in diameter, pyriform 6–10 × 12–24 μ.

Sabouraud's Broth (The above minus the agar).—Broth has turned dark with increased growth of flakes of mycelium. Surface shows a thick growth of Isabella-colored mycelium similar to that on the agar. Submerged mycelium of long hyphae approximately 2 μ in diameter with some variations; few swellings or racquet formations; clavate cells reduced in size.

Corn-Meal Agar (Product of Digestive Ferments Co., pH 6.0).—Growth poor, colony approximately 1.5 cm. in diameter after 43 days. Culture cottony with an irregular periphery, Isabella-colored. Cells and hyphae thicker, with the filaments 2–5 μ in diameter; conidia spherical or pyriform, approximately 5 μ in diameter; racquet mycelium present; spherical asci predominating, 6–22 μ in diameter; many thick-walled cells.

Potato-Dextrose Agar (pH 6.2).—Colony 5 cm. in diameter after 43 days. Culture cottony and somewhat flat with concentric rings of growth, color Isabella. Hyphae 2–4 μ in diameter; racquet mycelium and hyphal swellings; intercalary chlamydospores 5–7 μ in diameter; conidia 3–8 μ in diameter, both pyriform and spherical; many long filaments, approximately 100 μ, bearing a clavate cell terminally, the presumptive ascus; asci both spherical and pyriform, 6–22 μ in diameter.

Lactose Broth (Product of Digestive Ferments Co., pH 6.8).—Growth of submerged flakes of mycelium, with some Isabella-colored lumpy cottony colonies on the surface. Mycelium on surface similar to that on the agar; submerged mycelium of long hyphae approximately 2 μ in diameter; few hyphal swellings or racquet mycelium; few conidia or intercalary chlamydospores; many spherical and clavate terminal cells; cells much reduced in size.

Lactose Agar (The above plus 2 per cent agar).—Colony 3 cm. in diameter after 43 days. Culture cottony and somewhat flat except for a woolly periphery, color Isabella. Hyphae 2–3 μ

in diameter; conidia 3–5 μ in diameter, both spherical and pyriform; intercalary chlamydospores 3–7 μ in diameter; racquet mycelium and hyphal swelling present; spherical asci 6–20 μ in diameter, pyriform 6–12 × 10–22 μ.

Nutrient Agar (Product of Digestive Ferments Co., pH 7.0).—Growth similar to that on lactose agar.

Glycerine Agar (Beef extract agar plus 6 per cent glycerine, pH 7.2).—Colony approximately 4 cm. in diameter after 43 days. Culture cottony with center showing convolutions and a splitting of the agar. Color Isabella. Cells short and thick; racquet mycelium abundant with hyphal swellings; intercalary chlamydospores 5–8 μ in diameter; conidia spherical and pyriform, approximately 5 μ in diameter; spherical cells 8–9 μ in diameter present in series in a hypha; spherical asci up to 22 μ in diameter, pyriform 6–10 × 10–24 μ, with well-defined tubercles mostly spherical or blunt.

Serum Agar (Bacto-beef blood serum, product of Digestive Ferments Co., plus 2 per cent agar, pH 7.3).—Colony approximately 2.5 cm. in diameter after 43 days. Culture cottony, light Isabella, with a flat moist periphery suggestive of a yeast-like condition. Hyphae 2–3 μ in diameter; racquet mycelium abundant; conidia sessile or pedicellate, spherical or pyriform, approximately 5 μ in diameter; terminal subclavate to clavate cells; spherical asci 6–15 μ in diameter, and pyriform of varying proportions; intercalary chlamydospores 5–7 μ in diameter.

Endo's Agar (Product of Digestive Ferments Co., pH 7.5).—Colony approximately 3 cm. in diameter after 43 days. Culture cottony with the central portion red and a pink coloration spread throughout due to the absorption of the dye in the medium by the mycelium. Characteristics similar to those found on nutrient agar.

Gelatine.—No liquefaction by either species, or if present extremely slow.

Litmus Milk.—No acid or curdling, but an alkaline reaction which is interpreted as negative.

Carbohydrate Reactions.—No fermentation of any sugar used. No acid or gas production.

Discussion

The causative agent of histoplasmosis, as has been pointed out, has passed through a period of nomenclatorial change, due in all cases to the failure of the organism to grow on an artificial substrate. The original name *Histoplasma capsulatum* was assigned to it by Darling on the basis that it was a protozoon. He described the microbe as small, round or oval, 1–4 μ in diameter, possessing a polymorphous chromatin nucleus, basophilic cytoplasm, and achromatic spaces all enclosed within an achromatic refractile capsule. In smears, the parasite to him represented certain features found in protozoa by Leishman, Donovan, and several others. Furthermore, he thought he observed some forms possessing flagellae, and consequently he placed the organism in the Flagellidia, or the flagellates as we now know them.

This view was held for a number of years. In 1912 and 1913 da Rocha-Lima published papers dealing with lymphangitis in horses due to *Cryptococcus farciminosus.* He also studied material taken from cases of Darling's histoplasmosis, using the Romanowsky stain. On the basis of the differential staining reaction he concluded that the organism was a fungus of the genus *Cryptococcus* and closely related to *C. farciminosus.* His opinion was based also on the fact that the type of lesion produced simulated that of the above infection. Furthermore, with the Romanowsky dye, protozoa show up with a blue protoplasm within which is a large red clump called the macronucleus and also a smaller clump, the micronucleus or blepharoblast. This latter inclusion is lacking in Darling's organism. In addition, the type of division of the cell was suggestive of *Cryptococcus.* Da Rocha-Lima's idea was further emphasized by Castellani, Neveu-Lemaire (quoted by Vuillemin), and adhered to by most text-books.

The unfortunate circumstance in all this nomenclature was the fact that the organism was not cultured. The problem of naming a microbe of this kind, therefore, depends on the kind of growth obtained on an artificial substrate, in addition to the form in which it exists as a parasite. The morphology of an

organism is usually the first criterion that taxonomists consider in classification. In these two fungi, an association of these facts as described led to placing the two species in the genus *Posadasia* Canton, *Posadasia pyriformis* being a new species, and *P. capsulata* a new combination as published in a previous paper (Moore, '34).

The genus *Posadasia* was created by Canton in 1898 as the representative etiological agent of coccidioidal granuloma of South America. Da Fonseca and Areã Leão ('28) supposedly examined Posada's organism and found that the spores dehisced through the membrane. Such an observation might easily confuse an investigator and lead to an erroneous conclusion. Illustrations seem to show the organism in tissue to be similar to the asci here described on agar, a point further emphasized by Magalhães ('32) who illustrated the organism with tubercles and named it *Neogeotrichum pulmoneum.*

A series of papers by Floriano de Almeida ('33, '33a, '34, '34a) brings out a relationship between the organisms described here and *Coccidioides immitis* and *Paracoccidioides brasiliensis* as found in the tissues of individuals in South America (Brazil). He described particularly the latter, illustrating the typical club formation found in cultures of *Posadasia* and present in *Paracoccidioides brasiliensis.* It is quite evident that these organisms are closely related and that some, such as *Coccidioides immitis* and *Paracoccidioides brasiliensis,* as described by Almeida, have a specialized life cycle (Moore, '32). *Posadasia capsulata* and *P. pyriformis,* on the other hand, show a yeast-like stage in the host, a reduced condition which develops on artificial media to the type of reproductive body identical with that of *Paracoccidioides.*

Because of several observations made by various investigators, the genus *Posadasia* was made synonymous with *Coccidioides* by the author (Moore, '32). However, after examining *Posadasia capsulata* and *P. pyriformis,* and since the work of Almeida, it seems quite apparent that the genus should stand as an entity. It is on this basis that the two above species are established, showing a relationship to *Coccidioides immitis* of the family Coccidioideaceae and its relative *Paracoccidioides*

brasiliensis which should constitute a genus of the same family. Further, reviewing all data at hand, it seems that *Posadasia capsulata* and *P. pyriformis* form the connecting link between the family Coccidioideaceae and the family Endomycetaceae of the Endomycetales. These two fungi, therefore, occupy a position in the Coccidioideaceae, closely related to the family Endomycetaceae. On the basis of these views, the family Coccidioideaceae has the following members:

Coccidioideaceae
Posadasia
Posadasia capsulata
Posadasia pyriformis
Coccidioides
Coccidioides immitis
Paracoccidioides
Paracoccidioides brasiliensis
Rhinosporidium
Rhinosporidium Seeberi

In recent publications, Redaelli and Ciferri ('34; Ciferri and Redaelli, '34) have created the family Histoplasmaceae and included it with the families Nectaromycetaceae Cif. and Red. and Torulopsidaceae Cif. in the super family Adelosaccharomycetaceae Guilliermond, comprising all the non spore-bearing yeasts. Basing their evidence on the pathology of the host, cultural, morphological and biochemical reactions of the organisms, they place *Cryptococcus farciminosus* Rivolta and Micellone, 1883, and *Cryptococcus muris* Shortt, 1923, in the genus *Histoplasma,* with *H. capsulatum* as the type species. It is difficult to conceive of a relationship existing between these three fungi, and furthermore the presence of asci in *Histoplasma (Posadasia)* eliminates a family classification in the non spore-forming yeasts.

Summary

1. Two cases of Darling's histoplasmosis yielded two species, *Posadasia capsulata, P. pyriformis.*

2. The organisms were studied on many substrates covering

a fairly wide range of hydrogen-ion concentration and with a varying amount of carbohydrate and nitrogen.

3. *Posadasia capsulata* differs from *P. pyriformis* in its smaller size and amount of growth; spherical tuberculate asci as compared with both spherical and pyriform asci of the latter; white to light Isabella color as compared with Isabella to light cinnamon for the latter.

4. The organism occurs in the host as a small cell 1–4 μ in diameter. On an artificial substrate a mycelium is developed which is aerial and also submerged in the medium, giving rise to many characteristic cells as chlamydospores, conidia, racquet mycelium. Tuberculate asci develop from globose or clavate cells in the absence of a sexual act.

5. With these two species, the family Coccidioideaceae now has four genera and five species: *Posadasia capsulata, P. pyriformis, Coccidioides immitis, Paracoccidioides brasiliensis,* and *Rhinosporidium Seeberi.*

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Explanation of Plate

PLATE 11

Posadasia capsulata

All figures drawn as correctly as possible with the aid of a camera lucida at a magnification of × 1440 and reduced to × 750.

Fig. 1. Group of germinating spores and conidia on lactose agar.
Fig. 2. Hypha with clavate terminal cell on Sabouraud's agar.
Fig. 3. Mycelium on Raulin's agar.
Fig. 4. Racquet mycelium on Sabouraud's agar.
Fig. 5. Terminal clavate cell on wort agar.
Fig. 6. Terminal clavate cell on potato-dextrose agar.
Fig. 7. Terminal clavate cell on corn-meal agar.
Fig. 8. Racquet mycelium with terminal spherical cell on malt extract agar.
Fig. 9. Racquet mycelium on wort agar.
Fig. 10. Spherical hyphal enlargement on malt extract agar.
Fig. 11. Blastosporoid cell on Sabouraud's agar.
Fig. 12. Type of mycelium on malt extract agar.
Fig. 13. Hyphal swellings on Raulin's agar.
Fig. 14. Racquet formation on lactose agar.
Fig. 15. Racquet formation on corn-meal agar.
Fig. 16. Racquet formation on serum agar.
Fig. 17. Racquet formation on serum agar.
Fig. 18. Mycelium on Raulin's agar.
Fig. 19. Chlamydospore on wort agar.
Fig. 20. Lateral clavate cell, presumptive ascus on potato-dextrose agar.
Fig. 21. Terminal clavate cell, as fig. 20 on wort agar.
Fig. 22. Young terminal clavate swelling on potato-dextrose agar.
Figs. 23–25. Mycelium on Raulin's agar showing swellings, chlamydospores, and conidia.
Fig. 26. Young spherical cells, showing oil globules on potato-dextrose agar.
Fig. 27. Presumptive ascus on glycerine agar.
Fig. 28. Conidia on corn-meal agar.
Fig. 29. Young cell on thin filament, possibly a young ascus on Sabouraud's agar.
Fig. 30. Lateral thick-walled resting cell on corn-meal agar.
Fig. 31. Lateral clavate cell with oil globules on potato-dextrose agar.
Fig. 32. Type of mycelium on malt extract agar.
Fig. 33. Possible terminal hypnospore on wort agar.
Fig. 34. Blastosporoid cell on corn-meal agar.
Fig. 35. Spherical cell in lacto-phenol on Richards' agar.
Fig. 36. Young ascus in lacto-phenol, showing internal network on wort agar.
Fig. 37. Mycelium on wort agar.
Fig. 38. Mycelium on Raulin's agar.
Fig. 39. Mycelium on lactose agar.
Fig. 40. Lateral outgrowth which will probably develop an ascus on glycerine agar.
Fig. 41. Hyphal swellings on potato-dextrose agar.

EXPLANATION OF PLATE

PLATE 11 *(Continued)*

Posadasia capsulata

Fig. 42. Hyphal swellings on corn-meal agar.

Fig. 43. Young globose cell on lateral filament, on malt extract agar.

Fig. 44. Lateral pyriform conidium on potato-dextrose agar.

Fig. 45. Lateral spherical conidium on malt extract agar.

Fig. 46. Lateral chlamydospore on potato-dextrose agar.

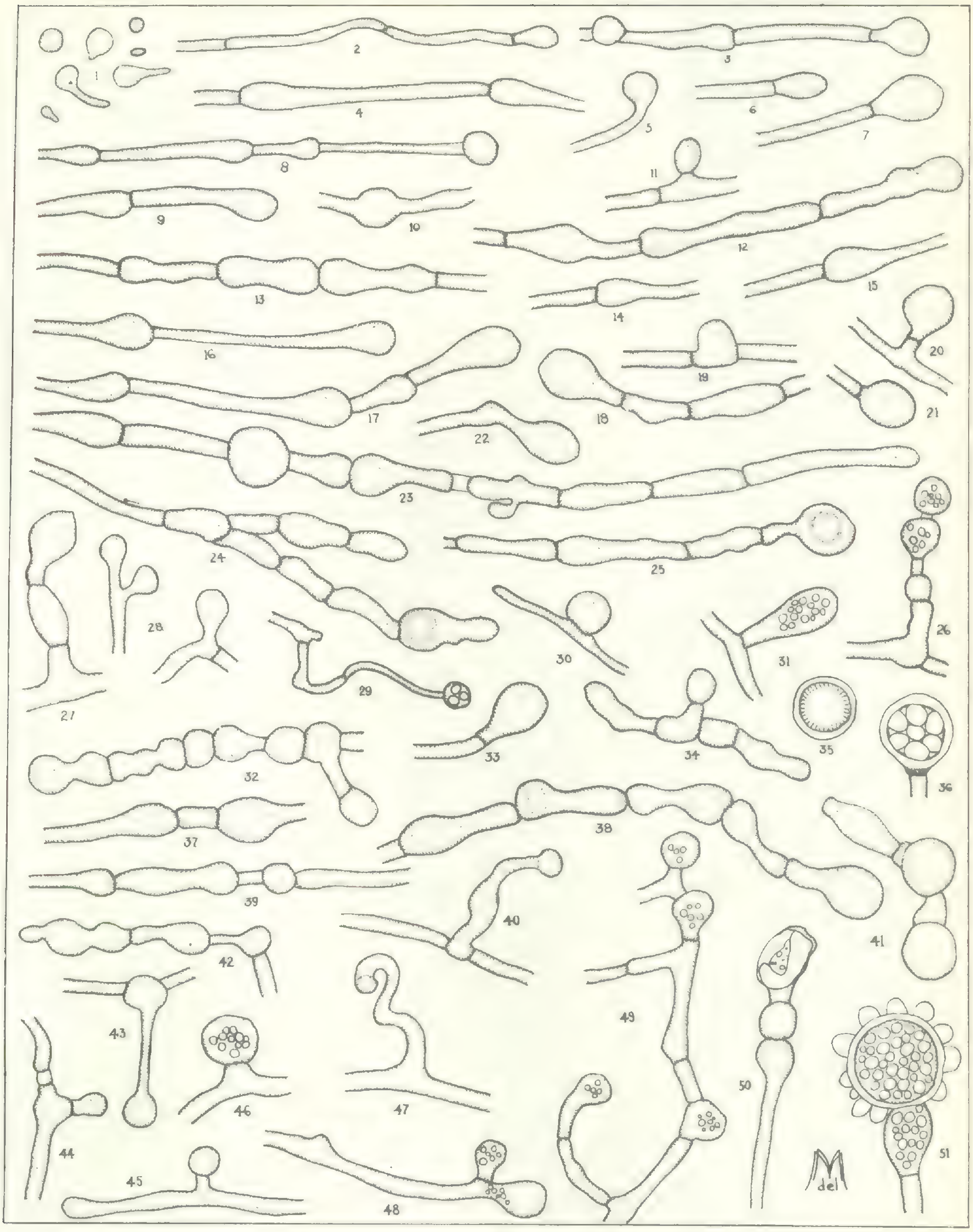
Fig. 47. Lateral outgrowth as fig. 40, on Richards' agar.

Fig. 48. Lateral pyriform conidium on Richards' agar.

Fig. 49. Mycelium on the same agar.

Fig. 50. Broken young ascus showing thick wall, on the same medium.

Fig. 51. Adult ascus in a water mount, showing oil globules on potato-dextrose agar.



MOORE—POSADASIA CAPSULATA

EXPLANATION OF PLATE

PLATE 12

Posadasia capsulata

All figures drawn as correctly as possible with the aid of a camera lucida at a magnification of × 1440 and reduced to × 750, except fig. 71, which was drawn at a magnification of × 960 and reduced to × 510.

Fig. 52. Mycelium on Richards' agar.

Fig. 53. Thick-walled cell below surface of Sabouraud's agar, probably a young ascus.

Fig. 54. Mycelium on potato-dextrose agar, showing lateral young asci.

Fig. 55. Mycelium with hyphal swellings on wort agar.

Fig. 56. Young ascus with fine prickles on Sabouraud's agar.

Figs. 57–58. Asci with blunt tubercles on wort agar.

Fig. 59. Large spherical cell on nutrient agar mounted in lacto-phenol, showing internal vacuolation.

Fig. 60. Mycelium on potato-dextrose agar, showing asci, conidia, and clavate terminal cell.

Figs. 61–63. Types of asci on wort agar.

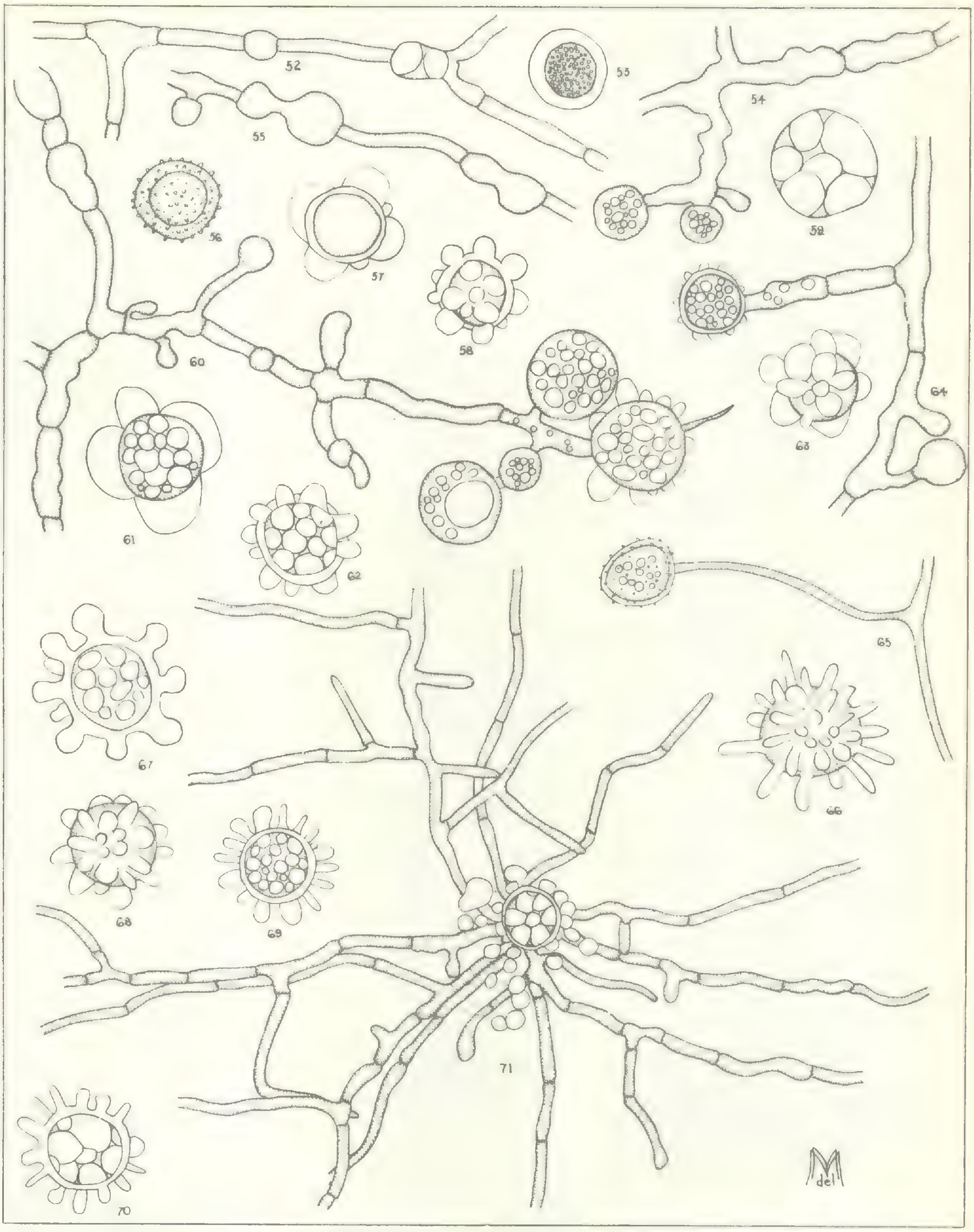
Figs. 64–65. Mycelium with asci on filaments, on potato-dextrose agar.

Figs. 66–68. Types of asci with different tubercles on wort agar.

Fig. 69. Ascus showing oil globules in a water mount from lactose agar.

Fig. 70. Ascus mounted in lacto-phenol, showing network of cell on nutrient agar.

Fig. 71. Ascus which had germinated in a gelatine slide culture, 10 days after inoculation.



MOORE—POSADASIA CAPSULATA

Explanation of Plate

PLATE 13

Posadasia pyriformis

All figures drawn as correctly as possible with the aid of a camera lucida at a magnification of × 1440 and reduced to × 750.

Fig. 72. Group of conidia, and small round cells, probably ascospores, on Sabouraud's agar.

Fig. 73. Filament with a clavate terminal portion on Raulin's agar.

Fig. 74. Hypha on serum agar.

Fig. 75. Mycelium with swellings on wort agar.

Fig. 76. Peculiar type of lateral branching on Richards' agar.

Fig. 77. Racquet mycelium on potato-dextrose agar.

Fig. 78. Branching of hypha on glycerine agar.

Fig. 79. Intercalary chlamydospore on Sabouraud's agar.

Fig. 80. Mycelium on Richards' agar.

Fig. 81. Racquet formation on malt extract agar.

Figs. 82–83. Enlarged cells on wort agar.

Fig. 84. Mycelium on glycerine agar.

Fig. 85. Mycelium on corn-meal agar.

Fig. 86. Thick hypha on Richards' agar.

Fig. 87. Swollen intercalary cell on Raulin's agar.

Fig. 88. Mycelium on wort agar.

Fig. 89. Intercalary chlamydospores on Raulin's agar.

Figs. 90–91. Mycelium on wort agar.

Fig. 92. Lateral outgrowth, showing an intercalary chlamydospore on Richards' agar.

Fig. 93. Terminal clavate cells on Raulin's agar.

Fig. 94. Lateral pedicel with a terminal clavate cell on potato-dextrose agar.

Figs. 95–96. Chains of spherical cells on serum agar.

Fig. 97. Racquet mycelium on corn-meal agar.

Fig. 98. Terminal clavate cell, showing oil globules, on Raulin's agar.

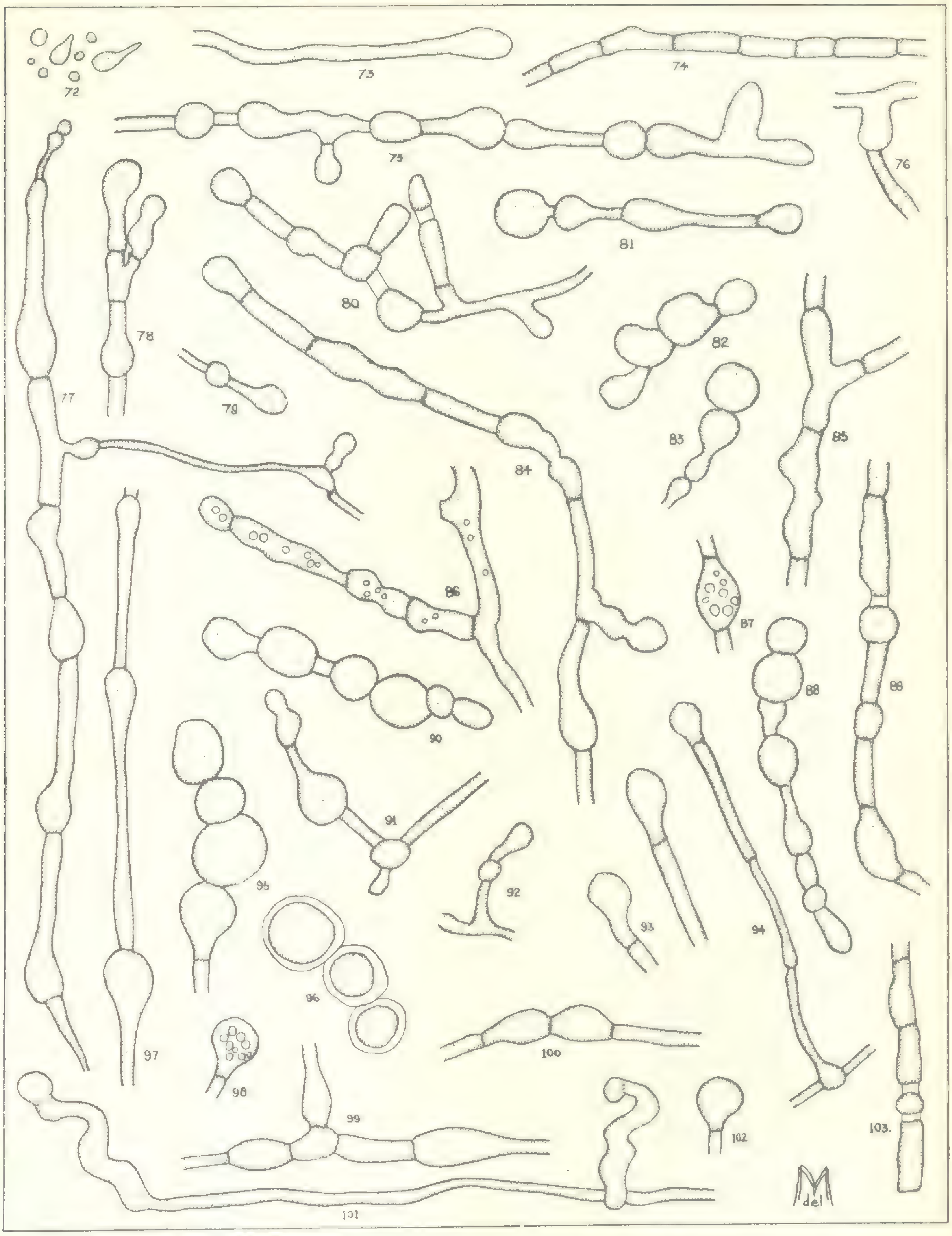
Fig. 99. Mycelium on Richards' agar.

Fig. 100. Hyphal swellings on glycerine agar.

Fig. 101. Mycelium showing snake-like processes which are presumptive asci bearers on Richards' agar.

Fig. 102. Terminal clavate cell on Raulin's agar.

Fig. 103. Mycelium showing intercalary chlamydospore on Raulin's agar.



MOORE—POSADASIA PYRIFORMIS

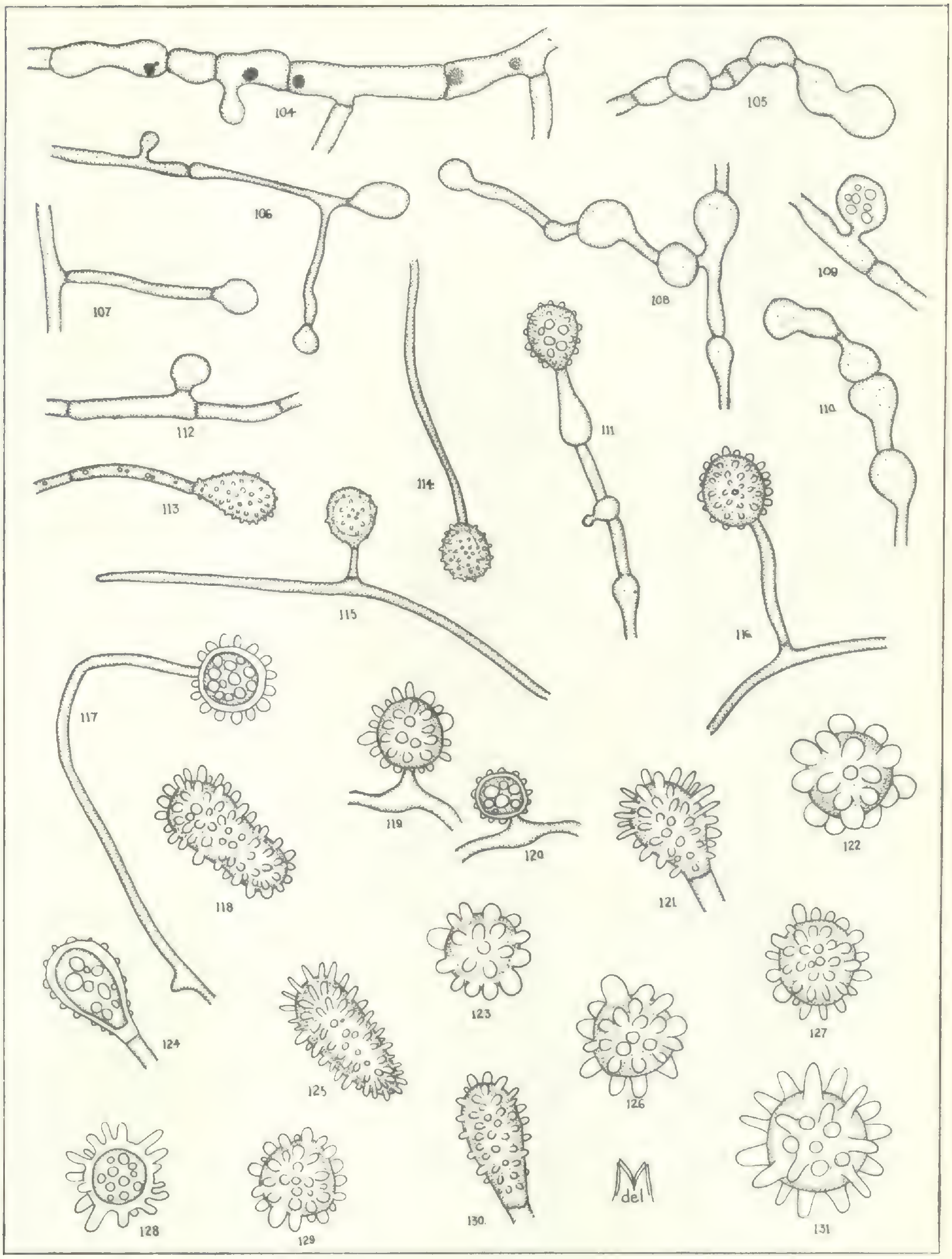
Explanation of Plate

PLATE 14

Posadasia pyriformis

All figures drawn as correctly as possible with the aid of a camera lucida at a magnification of × 1440 and reduced to × 750.

Fig. 104. Enlarged and thickened mycelium on corn-meal agar.
Fig. 105. Mycelium on wort agar.
Fig. 106. Mycelium showing lateral pedicellate clavate cell on Sabouraud's agar.
Fig. 107. Same as fig. 106, on corn-meal agar.
Fig. 108. Hyphal swellings on malt extract agar.
Fig. 109. Lateral outgrowth on potato-dextrose agar.
Fig. 110. Mycelium on malt extract agar.
Fig. 111. Terminal pyriform ascus on malt extract agar.
Fig. 112. Probably a conidium on Richards' agar.
Fig. 113. Terminal pyriform ascus on corn-meal agar.
Fig. 114. Same as fig. 113, on Sabouraud's agar.
Fig. 115. Lateral pedicellate ascus on corn-meal agar.
Fig. 116. Same as fig. 115, on the same medium.
Figs. 117–131. Various types of asci on different media.
Figs. 117, 119–120, 124, 126. On Richards' agar.
Figs. 118, 121, 125, 127, 129–130. On Raulin's agar.
Fig. 122. On glycerine agar.
Fig. 123. On Sabouraud's agar.
Fig. 128. On Czapek's agar.
Fig. 131. On potato-dextrose agar.



MOORE—POSADASIA PYRIFORMIS

AN IMPROVED APPARATUS FOR THE DETERMINATION OF CARBON DIOXIDE PRODUCTION IN PHYSIOLOGICAL PLANT STUDIES

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The method of determining carbon dioxide production described previously[1] has been used in this laboratory for various types of experiments over a period of two years, particularly in determining the respiration of plants in water culture. At first sight the construction of the apparatus seems complicated, but once assembled it is extremely simple. The manipulation consists of adjusting the stopcocks M and W and detaching and weighing the Fleming-Martin bulb. Five units attached to a single water-pump suction line have been successfully operated. One charging of the various chambers with the necessary chemicals is sufficient for months of use.

Experience with the apparatus has suggested the advisability of several modifications of the original construction. The calcium chloride Tower B has been added to prevent the atmospheric moisture from wetting the Ascarite in C. Stopcock A, through which the air enters, is closed when the apparatus is not in use. C is a large test-tube, 32 × 300 mm., and its inlet should terminate near the stopper and the outlet should be from the bottom, in order that the air may be drawn down through the entire mass of Ascarite and thus prevent channelling.

Two calcium-chloride towers, H and I, have replaced the former tube of concentrated sulphuric acid for the first stage of the dehydration of the air passing through the bell jar serving as the respiration chamber. This prevents the negative pressure of about one pound per square inch which existed in the carbon-dioxide absorbing part of the system when sul-

[1] Wynd, F. Lyle. An apparatus for the determination of carbon dioxide production in physiological plant studies. Ann. Mo. Bot. Gard. **19**: 499–501. 1932.

phuric acid was used. Even this small negative pressure greatly increases the likelihood of leaks and limits the number of units which may be attached to the common suction line V. It has been found also that volatile substances from plants are oxidized when drawn through concentrated sulphuric acid, and that the resulting carbon dioxide and sulphur dioxide sometimes produce large errors.

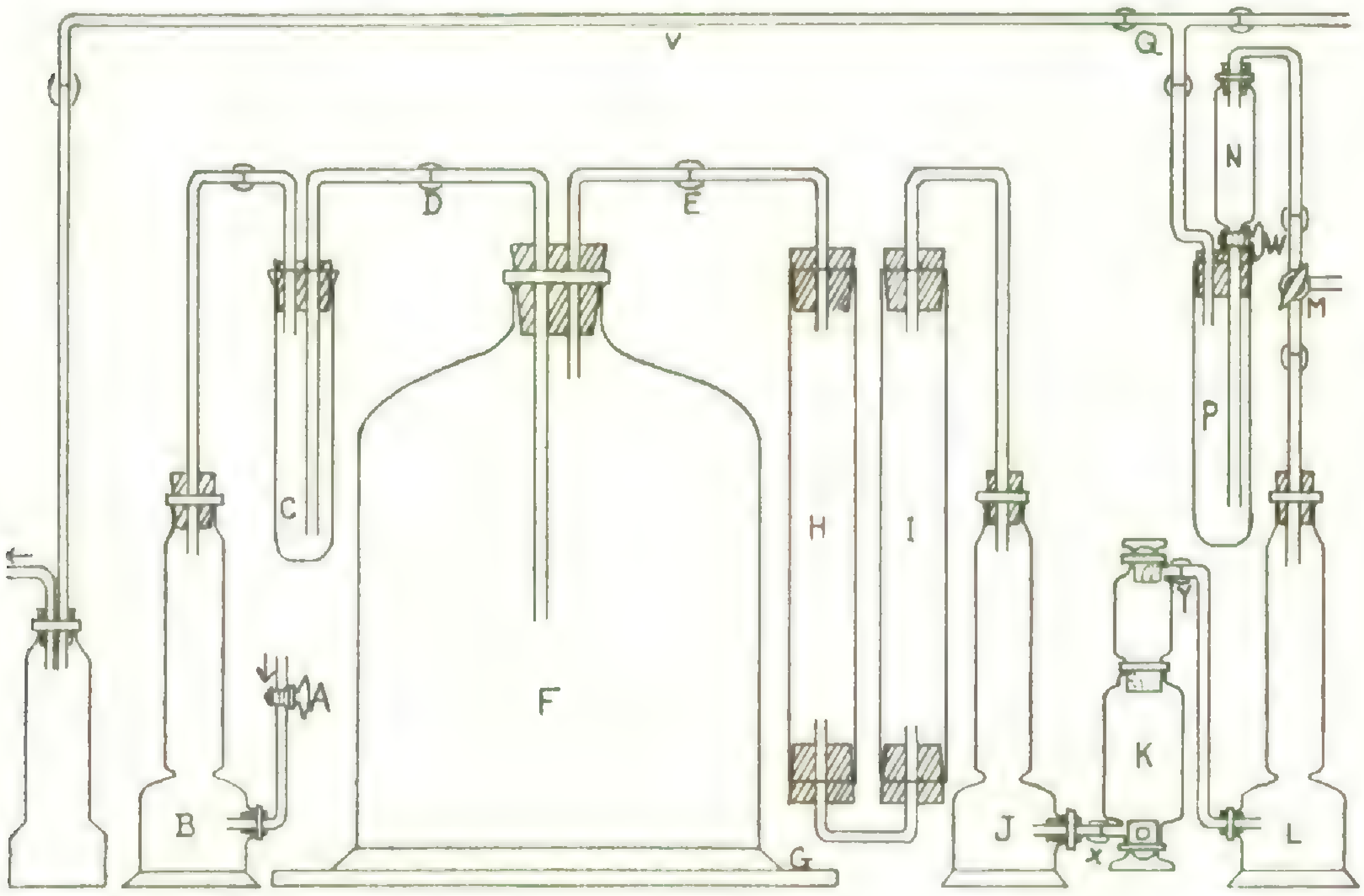

Fig. 1. Explanation in text.

The final stage of drying the air from the respiration chamber is accomplished by the tower J, which is filled with Desicchlora. This drying agent absorbs ammonia as well as water and therefore eliminates the use of a separate structure to remove this omnipresent contamination of laboratory air. The use of phosphorus pentoxide at this stage is very unsatisfactory because of its tendency to channel. The carbon-dioxide absorption bulb is the Fleming-Martin type which has been found very satisfactory for this purpose. The upper chamber is filled with Desicchlora, the lower with Ascarite. Tower L is filled with Desicchlora. M is a three-way stopcock. P is half filled with water and serves as an indicator for the regulation of the flow of air through the apparatus.

In the operation of the unit, cock W is closed and chamber N is connected to tower L through the three-way stopcock, M. After the suction has been turned on, cock W is slowly opened until the desired rate of flow is obtained. In stopping the experiment the three-way stopcock M must be turned so that air enters through its side arm, then the cock W is closed and the suction stopped. After the suction stops, W may be opened and water will not back up in the system and ruin the drying agent in L. Cock M closes off the tower L from the air and from N when the apparatus is not in use.

The apparatus may be operated for periods of twelve hours and even longer, and amounts of carbon dioxide up to several grams may be determined with an experimental error of less than one milligram if the usual analytical precautions are taken. All joints should be sealed with shellac. The detachable rubber connections at D and E should be sealed with grease. The rubber connections of the Fleming-Martin bulb should be carefully wired with copper wire. The contact of the respiration chamber with the glass plate G should be sealed by vaseline. The absorption bulb must be handled with cheesecloth, and a counterpoise, preferably another Fleming-Martin bulb, should be used in weighing. The tower J must be completely filled with the drying agent and the short glass-tube outlet should be loosely filled with cotton. If these precautions are not taken, sufficient carbon dioxide, moisture, or ammonia may accumulate in the lower part of J, when the Fleming-Martin bulb is detached for weighing, to cause an appreciable error in the next determination.

Since calcium chloride always contains some calcium oxide, the towers containing this substance must be saturated with carbon dioxide before the apparatus is used for the first time. Further details are contained in the author's original paper.

NEW SPECIES OF HYDNANGIACEAE

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Since the publication of our monograph of the Hydnangiaceae has been unavoidably delayed, it seems desirable to record the following new species and new combinations in this group.

ARCANGELIELLA **africana** (Lloyd) Zeller & Dodge, comb. nov.

Octaviania africana Lloyd, Myc. Notes 67: 1142. 1922.

Octaviana africana Verwoerd, S. Afr. Jour. Sci. **22**: 164. 1925.

ARCANGELIELLA **alveolata** (Cooke & Massee) Zeller & Dodge, comb. nov.

Octaviania alveolata Cooke & Massee, Grevillea **16**: 2. 1887.

Octavianina alveolata O. Kuntze, Rev. Gen. Pl. **3**[2]: 501. 1898.

Gymnomyces pallidus Massee & Rodway, Kew Bull. Misc. Inf. **1898**: 125. 1898.

Elasmomyces russuloides Setchell, Jour. Mycol. **13**: 240–241. 1907.

Hydnangium glabrum Rodway, Papers & Proc. Roy. Soc. Tasmania **1920**: 157. 1921.

ARCANGELIELLA **ambigua** Zeller & Dodge, sp. nov.

Fructificationes pyriformes vel irregulares, lobatae, ad 5 cm. diametro metientes, sordide albidae tactu caerulescentes nigrescentesque, ''honey-yellow'' vel ''light brownish olive'' siccatae, superficie glabra, rimosa; basis sterilis prominens, stipitiformis, suberosa; columella prominens percurrensque; peridium crassissimum, ad 1500 μ crassitudine, secernibile, hyphis magnis, dense contextis, 4–7.5 μ diametro, lactiferis, cum hyphis et funiculis prosenchymaticis (hyphis tenuioribus ad glebam); gleba ''chocolate'' vel ''wine color,'' ''blackish brown'' vel ''antique brown'' et ''auburn'' siccata, locellis parvis, sinuosis; septa 35–45 μ crassitudine,

Issued May 25, 1935.

fragilia, hyphis magnis dense contextis, lactiferis cum hyphis; basidia 20–24 × 6–8 μ, clavata, 2- vel 4-spora, sterigmatibus brevibus; sporae obscure brunneae, ovoideae vel ovoideo-citriformes, utriculo inconscipuo, 9–10-rugoso, immaturae 13–15 × 8–9 μ, maturae 11–12.5 × 8–11 μ.

California: Santa Clara County, Saratoga, *Dale Parks*, type (in Univ. Cal. Herb., as H. E. Parks 825 and Z 31; also in Dodge Herb. and Zeller Herb.).

Arcangeliella **asterosperma** (Vittadini) Zeller & Dodge, comb. nov.

Octaviania asterosperma Vittadini, Monogr. Tuberac. 17. 1831.

var. **depauperata** (Tulasne) Zeller & Dodge, comb. nov.

Octaviania asterosperma var. *depauperata* Tulasne, Fung. Hypog. 78. 1851.

Octaviania vacua Tulasne, herb. nom.

var. **hololeuca** (Hesse) Zeller & Dodge, comb. nov.

Octaviania asterosperma var. *hololeuca* Hesse, Hypog. Deutschl. **1**: 74. 1891.

Arcangeliella **Beccari** (Petri) Zeller & Dodge, comb. nov.

Clathrogaster Beccari Petri, Malpighia **14**: 126. 1900.

Arcangeliella **Behrii** (Harkness) Zeller & Dodge, comb. nov.

Splanchnomyces Behrii Harkness, Bull. Cal. Acad. Sci. **1**: 30. 1884.

Hymenogaster Behrii De Toni in Sacc. Syll. Fung. **7**: 174. 1888.

var. **caudata** Zeller & Dodge, comb. nov.

Arcangeliella caudata Zeller & Dodge, Ann. Mo. Bot. Gard. **6**: 49–52. 1919.

Arcangeliella **brunneola** (Harkness) Zeller & Dodge, comb. nov.

Octaviania brunneola Harkness, Proc. Cal. Acad. Sci. Bot. III. **1**: 251. 1899.

Octaviania microsporium Mattirolo, herb. nom.

Arcangeliella **Campbellae** Berkeley & Broome, sp. nov.

Hymenogaster Campbellii Berkeley & Broome, nom. herb.

Fructificationes subsphericae, obovoideae vel lobatae, inferne attenuatae, 1–2.5 cm. diametro metientes, caespitosae, violascentes, "clay color" vel "tawny olive"

siccatae, superficie glabra; basis sterilis conica, in glebam prominens vel percurrens; columella adest, inferne attenuata, stipitiformis, spongiosa, prosenchymatica, hyphis hyalinis; peridium 100–115 μ crassitudine, hyphis gelificatis hyalinis contextis, periclinalibus in superficie, diagonalibus in strato extero, laxe periclinalibus in strato medio et dense periclinalibus in strato intero; gleba "ochraceous tawny" siccata, locellis ab basi sterili radiantibus; septa scissilia, hyalina, prosenchymatica, 14–22 μ crassitudine; basidia non visa; sporae ellipsoideae, apice obtuso, subpedicellatae, brunneae, 8–10 (–11) × 4.4–5.6 (–7) μ, minute foveolatae.

AUSTRALIA: Victoria, Melbourne (Lilydale), *F. Campbell 27a (Mrs. Martin 429)* (in Kew Herb., Lloyd Mus. 0229, and N. Y. Bot. Gard. Herb. marked "from Massee Herb.").

ARCANGELIELLA **cremea** Zeller & Dodge, sp. nov.

Fructificationes irregulares, subreniformes, 1 × 2 × 2 cm., "light buff" vel "cinnamon buff" siccatae; columella cremea percurrens; peridium variabile crassitudine ad 250 μ, hyphis magnis, periclinalibus, prosenchymaticum, lactiferis cum hyphis; gleba firma, "cinnamon buff"; septa 120–130 μ crassitudine, pseudoparenchymatica, paucis cum hyphis magnis periclinalibus in strato medio; basidia brevia, cylindrica, 14 × 8 μ, sterigmatibus tenuibus, ad 4 μ longitudine; sporae sphericae, luteae, alveolatae, dein ad 24 echinis in circulo magno, 9–11 μ diametro.

OREGON: Benton County, Scott's Hill south of Corvallis, *R. Sprague*, type (in Zeller Herb. 7927, and in Dodge Herb.).

ARCANGELIELLA **Curtisii** Zeller & Dodge, sp. nov.

Hydnangium Ravenelii Farlow in Foerste, Bot. Gaz. **19**: 37. 1894, non aliorum.

Fructificationes 0.7–1.4 cm. diametro, "isabella color" vel "brownish olive" siccatae; peridium 100–300 μ crassitudine, hyphis periclinalibus, tenuibus, in fibrillis lactiferis cum hyphis contextis; gleba "pinkish buff" vel "cinnamon buff" siccata; septa 30–40 μ crassitudine, stupposa, scissilia; basidia non visa; sporae subsphericae vel late ellipsoideae, 8–11 × 7.4–9 μ, aspere reticulatae.

SOUTH CAROLINA: Darlington County, Society Hill, *M. A. Curtis*, type (Mo. Bot. Gard. Herb. 5647, and in Curtis Herb. at Farlow Herb.).

ARCANGELIELLA **ellipsoidea** Zeller & Dodge, sp. nov.

Fructificationes 0.7–3.0 cm. diametro et 1–2 cm. altitudine, depresso-globosae, pyriformes vel reniformes, "honey-yellow" vel "isabella color" siccatae; basis sterilis prominens; columella percurrens; peridium 170–350 μ crassitudine, prosenchymaticum, cellulis magnis, cum funiculis periclinalibus hyphisque lactiferis; gleba "cinnamon rufous" vel "hazel," locellis magnis; septa 30–65 μ crassitudine, prosenchymatica, facile scissilia; basidia non visa; sporae ovoideae immaturae, ellipsoideae maturae, obscure brunneae, minute alveolatae, 10–12 × 6–7.4 μ.

TASMANIA: Hobart, *L. Rodway 1286*, type (in Dodge Herb.).

ARCANGELIELLA **Gardneri** (Zeller & Dodge) Zeller & Dodge, comb. nov.

Gymnomyces Gardneri Zeller & Dodge, Ann. Mo. Bot. Gard. **6**: 54–55. 1919.

ARCANGELIELLA **glabrella** Zeller & Dodge, sp. nov.

Fructificationes 1–1.5 cm. diametro (0.5–1.0 cm. siccatae) metientes, subsphericae vel depresso-globosae, glabrae, albidae vel brunnescentes, sordide albidae vel "buckthorn-brown" siccatae; columella percurrens, fibrosa, lactiferis cum hyphis insulisque parenchymaticis; peridium ad 640 μ crassitudine superne vel 80–130 μ inferne, pseudoparenchymaticum, cellulis magnis superficie hyphis dense contextis et lactiferis cum hyphis; gleba alba, "ivory yellow" vel "cream buff" siccata; septa tenuia, scissillima, locellis subsphericis, hyphis periclinalibus lactiferisque; cystidia in finibus hypharum lactiferarum, cylindrica, rupta, spheras laticis exudentia; basidia non visa; sporae hyalinae, laeves vel superne subrugosae, pedicellatae, subsphericae, 4–6 μ diametro.

TASMANIA: Kingston, Leslie Road, *L. Rodway 1111*, type (in Lloyd Mus., Dodge Herb., and Zeller Herb.).

ARCANGELIELLA **krjukowensis** (Bucholtz) Zeller & Dodge, comb. nov.

Secotium (Elasmomyces) krjukowense Bucholtz, Hedwigia **40**: 314–315. 1901.

var. **michailowskjana** (Bucholtz) Zeller & Dodge, comb. nov.

Secotium (Elasmomyces) michailowskjanum Bucholtz, Hedwigia **40**: 315. 1901.

ARCANGELIELLA **laevis** (Hesse) Zeller & Dodge, comb. nov.

Octaviania laevis Hesse, Hypog. Deutschl. **1**: 80–81. 1891.

Octavianina laevis O. Kuntze, Rev. Gen. Pl. **3**^{2}: 501. 1898.

Octaviania levis Sacc. Syll. Fung. **11**: 169. 1895.

ARCANGELIELLA **nana** (Massee & Rodway) Zeller & Dodge, comb. nov.

Hymenogaster nanus Massee & Rodway, Kew Bull. Misc. Inf. **1899**: 180. 1899.

ARCANGELIELLA **occidentalis** (Harkness) Zeller & Dodge, comb. nov.

Octaviania occidentalis Harkness, Proc. Cal. Acad. Sci. Bot. III. **1**: 253. 1899.

ARCANGELIELLA **pilosa** Zeller & Dodge, sp. nov.

Fructificationes 3–4.5 cm. diametro, 1–4 cm. altitudine metientes, sphericae vel depresso-pyriformes, contractae siccatae, albidae, rufescentes, "citrine drab,"

''light brownish olive'' vel ''olive'' siccatae, laeves, pilosae; basis sterilis prominens; columella ramosa, percurrens, hyphis laxe implexis; peridium 500–1000 μ crassitudine recens (240–320 μ siccatum), prosenchymaticum, gelificatum, lactiferis cum hyphis, superficie hyphis radialibus, 30–40 μ longitudine, pilosa; gleba firma, gelificata, ''buff,'' dura, ''cinnamon'' vel ''Saccardo's umber'' siccata, locellis parvis, vacuis collabentibus; septa 20–35 μ crassitudine, hyphis tenuibus, laxe implexis, lactiferis cum hyphis; basidia clavata, tetraspora; sporae hyalinae, subsphericae, minute alveolatae, echinulatae, 10–12 μ diametro.

CALIFORNIA: Santa Clara County, Guadaloupe, *H. E. Parks 4th, Z340*, type, *524, 525* (in Zeller Herb. and Dodge Herb.).

ARCANGELIELLA **scissilis** Zeller & Dodge, sp. nov.

Fructificationes irregulares, ad 3 cm. diametro, superficie glabra, lutescentes, ''tawny'' siccatae; columella tenuis, alba, mediam fructificationis attingens; peridium lentum, facile secernibile, 320–400 μ crassitudine siccatum, pseudoparenchymaticum, superficie prosenchymatica, lactiferis cum hyphis; gleba cremea, ''antimony yellow'' siccata, densa; septa 25–35 μ crassitudine, prosenchymatica, lactiferis cum hyphis; basidia non visa; sporae sphericae, minute alveolatae, echinulatae, obscure luteae, 11–15 μ. Odor *Hamamelidis virginianae*.

CALIFORNIA: Humboldt County, Trinidad, *H. E. Parks 4125*, type (in Zeller Herb.).

ARCANGELIELLA **socialis** (Harkness) Zeller & Dodge, comb. nov.

Octaviania socialis Harkness, Proc. Cal. Acad. Sci. Bot. III. **1**: 252. 1899.

ARCANGELIELLA **tasmanica** (Kalchbrenner) Zeller & Dodge, comb. nov.

Hydnangium tasmanicum Kalchbrenner in Massee, Grevillea **19**: 95. 1891.

ARCANGELIELLA **violacea** (Massee & Rodway) Zeller & Dodge, comb. nov.

Hymenogaster violaceus Massee & Rodway, Kew Bull. Misc. Inf. **1898**: 127. 1898.

ARCANGELIELLA **vulvaria** (Petri) Zeller & Dodge, comb. nov.

Clathrogaster vulvarius Petri, Malpighia **14**: 126. 1900.

MACOWANITES **magnus** Parks, sp. nov.

Pileus 3–14 cm. diametro agariciformis, irregulariter expansus, conicus immaturus, subplanus maturus, marginibus irregularibus vel sinuosis; superficies laevis, viscida, ''pale tan'' vel obscure brunnea recens, ''fawn-brown'' vel ''army-brown'' vel ''cinnamon-buff'' siccata; stipes brevis, 3–7 cm. longitudine, crassus, ad 3 cm., albus, fragilis, bulbosus, inferne attenuatus, subglaber vel innato-fibrillosus, hyphis

longitudinalibus, tenuibus; gleba alba, "warm buff" vel vinacea siccata, spongiosa ut in *Gautieria morchelliformi*, locellis ab stipite radiantibus, liberis vel adnexis, inferne aperta, superne peridio tecta; peridium duplex, strato intero 250–380 μ crassitudine, laxe stupposo, funiculis hyphis tenuibus, strato extero 70–120 μ, compacto, stupposo, hyphis gelificatis, viscido, locellis magnis, labyrinthiformibus; septa ad 170 μ (ad 95 μ inter hymenia) crassitudine, stupposa, strato subhymeniali pseudoparenchymatico; basidia magna, cylindrica vel subclavata, bisporigera, 20–24 × 10–11 μ, sterigmatibus brevibus; sporae subsphericae, echinis brevibus, minutis, hyalinae, 7.5–10 μ diametro. Odor saporque *Lactarii* dein pungens.

CALIFORNIA: Santa Clara County, Call-of-the-Wild, *H. E. Parks 208*, type (in Univ. Cal. Herb., Dodge Herb., and Zeller Herb. 2804).

ELASMOMYCES **borneensis** (Petri) Zeller & Dodge, comb. nov.
Octaviania borneensis Petri, Malpighia **14**: 128. 1900.

ELASMOMYCES **echinosporus** Zeller & Dodge, comb. nov.
Macowanites echinosporus Zeller & Dodge, Ann. Mo. Bot. Gard. **6**: 57–58. 1919.

SCLEROGASTER **Broomeianus** Zeller & Dodge, sp. nov.
Octaviania compacta Massee, Ann. Bot. **4**: 32–33. 1889 [often cited as Monog. Brit. Gast. 32–33. 1889].

SCLEROGASTER **candidus** (Tulasne) Zeller & Dodge, comb. nov.
Hydnangium candidum Tulasne, Ann. Sci. Nat. Bot. II. **19**: 376. 1843.

SCLEROGASTER **hysterangioides** (Tulasne) Zeller & Dodge, comb. nov.
Hydnangium hysterangioides Tulasne, Fung. Hypog. 76. 1851.
Octaviania hysterangioides Lloyd, Myc. Notes 67: 1141. 1922.

SCLEROGASTER **luteocarneus** (Bresadola) Zeller & Dodge, comb. nov.
Octaviania luteocarnea Bresadola, Ann. Myc. **18**: 54. 1920.

SCLEROGASTER **pacificus** Zeller & Dodge, sp. nov.

Fructificationes subsphericae, 0.8–1.0 cm. diametro metientes, albidae; basis sterilis adest; columella non visa; peridium evanescens, ad 100 μ crassitudine, pseudoparenchymaticum, cellulis 20 × 30 μ; gleba "ochraceous buff," firma, deinde friabilis, locellis polyhedricis, sporis impletis; septa tenuia, 20–30 μ crassitudine, hyphis tenuibus, laxe implexis; basidia clavata, evanescentia; sporae sphericae, verrucis magnis, 9–10 in circulo magno, 7–8 μ diametro.

OREGON: Coos County, Bandon, *S. M. Zeller 7425* (in Zeller Herb. and Dodge Herb.).

SCLEROGASTER **siculus** Zeller & Dodge, sp. nov.

Sclerogaster lanatus Mattirolo, Malpighia **14**: 85–86. 1900, non Hesse.

Fructificationes 0.6 × 0.4 cm. diametro metientes, depresso-globosae, albidae, floccosae; peridium duplex, strato extero variabili crassitudine, hyphis tenuibus contextum, strato intero ad 90 μ crassitudine, hyphis periclinalibus dense contextum; gleba ochraceo-fulva, locellis sporis impletis; septa ad 30 μ inter hymenia, hyphis periclinalibus; basidia evanescentia; sporae brunneae, sparse minuteque echinatae, episporio crasso.

ITALY: Sicily, Fanfani a Cefalù, forest of S. Cosimo, *O. Mattirolo* (in Dodge Herb.).

HYDNANGIUM **Archeri** (Berkeley) Zeller & Dodge, comb. nov.

Octaviania Archeri Berkeley in J. D. Hooker, Bot. Antarctic Voy. III. Fl. Tasmaniae **2**: 263–265. 1859.

HYDNANGIUM **citrinum** (Harkness) Zeller & Dodge, comb. nov.

Octaviania citrina Harkness, Proc. Cal. Acad. Sci. Bot. III. **1**: 252. 1899; Sacc. & Sydow in Sacc. Syll. Fung. **16**: 248–249. 1902.

HYDNANGIUM **Eisenii** (Harkness) Zeller & Dodge, comb. nov.

Melanogaster Eisenii Harkness, Proc. Cal. Acad. Sci. Bot. III. **1**: 259. 1899.

HYDNANGIUM **Gilkeyae** Zeller & Dodge, sp. nov.

Fructificationes oblongae vel subsphericae, ad 4.5 × 3 × 3 cm. metientes, fragiles, superficie glabra, venis innato-reticulatis, "buff," brunneo-maculatae, "pinkish buff" vel "tawny olive" siccatae, venis obscurioribus; basis sterilis non visa; peridium 150–200 μ crassitudine, 70–85 μ siccatum, prosenchymaticum, stupposum siccatum; gleba alba vel cremea recens, "pale orange yellow" vel "maize-yellow" siccata; septa 35–40 μ crassitudine, scissilia in angulis, hyphis magnis laxe implexis; basidia uni- vel bispora, clavata; sporae subsphericae, luteo-brunneae, echinis magnis, 3–3.5 μ longis, episporio 0.7–1.0 μ crassitudine, pedicellatae, 18–22 × 14.5–18.5 μ echinis inclusis.

OREGON: Linn County, near the Peoria road, *Helen M. Gilkey*, type (in Oregon State College Herb., Dodge Herb., and Zeller Herb. 2334).

HYDNANGIUM **Hessei** (O. Kuntze) Zeller & Dodge, comb. nov.

Octavianina Hessei O. Kuntze, Rev. Gen. Pl. 3^2: 501. 1898.

HYDNANGIUM **laeve** (Hesse) Zeller & Dodge, comb. nov.
Octaviania laevis Hesse, Hypog. Deutschl. **1**: 80–81. 1891.
Octavianina laevis O. Kuntze, Rev. Gen. Pl. **3**[2]: 501. 1898.
Octaviania levis Sacc. Syll. Fung. **11**: 169. 1895.

HYDNANGIUM **lanigerum** (Hesse) Zeller & Dodge, comb. nov.
Octaviania lanigera Hesse, Hypog. Deutschl. **1**: 79–80. 1891; Sacc. Syll. Fung. **11**: 169. 1895.
Octavianina lanigera O. Kuntze, Rev. Gen. Pl. **3**[2]: 501. 1898.

HYDNANGIUM **luteum** (Hesse) Zeller & Dodge, comb. nov.
Octaviania lutea Hesse, Jahrb. f. wiss. Bot. **16**: 255. 1885.

HYDNANGIUM **mistiforme** (Mattirolo) Zeller & Dodge, comb. nov.
Martellia mistiformis Mattirolo, Malpighia **14**: 78–82. 1900.

HYDNANGIUM **monticola** (Harkness) Zeller & Dodge, comb. nov.
Octaviania monticola Harkness, Proc. Cal. Acad. Sci. Bot. III. **1**: 254. 1899.

HYDNANGIUM **pusillum** Harkness, sp. nov.
Octaviania pusilla Harkness, herb. nom.

Fructificationes 1 cm. diametro metientes, cinnamomeae; basis sterilis prominens, hemispherica, cum stipite tenui, brevi; peridium ad 200 μ crassitudine, hyphis hyalinis, periclinalibus; gleba ''buckthorn-brown,'' locellis magnis, irregularibus, vacuis; septa 100 μ crassitudine, hyphis tenuibus, hyalinis, gelificatis; basidia late clavata, bispora, sterigmatibus 3–4 μ longis; sporae 15 μ diametro, echinis longis, tenuibus.

CALIFORNIA: *H. W. Harkness 282*, type (in Dudley Herb. at Leland Stanford Jr. Univ.).

HYDNANGIUM **Soehneri** Zeller & Dodge, sp. nov.

Fructificationes sphericae vel reniformes, 0.6 ×0.9 cm., nigro-brunneae vel nigrae siccatae; basis sterilis columellaque non visae; peridium 50–60 μ crassitudine, prosenchymaticum, cellulis parvis, gelificatis; gleba ''Sudan brown,'' locellis magnis, vacuis; septa tenuia, subscissilia, hyphis magnis, brunneis, laxe implexis; basidia magna, cylindrica, celeriter collabentia; sporae ellipsoideae, obscure brunneae, 15.4–18.2 × 12.4–14 μ.

GERMANY: Bayern, Wolfratshausen, Pupplinger Heide, *E. Soehner*, type (in Soehner Herb. and Dodge Herb.).

HYDNANGIUM **Thaxteri** Zeller & Dodge, sp. nov.

Fructificationes sphericae, rubrae, ''capucine yellow'' siccatae; columella inconspicua si vere adsit; peridium 125–130 μ crassitudine, strato extero 30 μ crassitudine,

hyphis tenuibus dense contextum, strato intero 100 μ crassitudine, hyphis majoribus laxe implexis, subpericlinalibus; gleba "orange buff" vel "light ochraceous buff," locellis minutis; septa 50–60 μ crassitudine, hyphis tenuibus contextis, subhymenio pseudoparenchymatico; basidia brevia, cylindrica, sterigmatibus longis; sporae 7–8 μ diametro, sphericae, echinis 20–24, tenuibus, in circulo magno.

CHILE: Concepción, *R. Thaxter* (in Farlow Herb.).

HYDNANGIUM **tuberculatum** (Hesse) Zeller & Dodge, comb. nov.

Octaviania tuberculata Hesse, Hypog. Deutschl. **1**: 75–77. 1891; Sacc. Syll. Fung. **11**: 169. 1895.

Octavianina tuberculatum O. Kuntze, Rev. Gen. Pl. **3**^{3}: 501. 1898.

MELANOGASTER AMBIGUUS (Vittadini) Tulasne, Ann. Sci. Nat. Bot. II. **19**: 378. 1843.

var. **eurysperma** Zeller & Dodge, var. nov.

Fructificationes sphericae vel irregulares, ad 3.5 cm. diametro metientes, "snuff-brown" vel "bister," immutabiles siccatae, superficie laevi; fibrillae paucae, concolores, non radiantes, adnato-appressae; peridium crassum, 320–400 μ crassitudine, hyphis obscure brunneis, subvesiculosis, stupposis, magnitudine variabilibus; gleba septis albis, flavescentibus siccatis, locellis nigerrimis, gelificatis, ad 3 mm. diametro; septa hyphis tenuibus, ad 2.5 μ diametro; basidia pyriformia, 5 × 7 μ, pedicellis longis, 2.5 μ diametro, tetraspora, sterigmatibus brevibus ad 3 μ longitudine; sporae ellipsoideae vel citriformes, nigrae, 10–11 × 7.5–9 μ. Odor vini rhenani.

OREGON: Polk County, Rickreall, *Etta Neidheiser*, type (in Zeller Herb. 2660, and in Dodge Herb.).

By a regrettable error the new combination *Hymenogaster viscidus* was not so designated in our previous paper (Ann. Mo. Bot. Gard. **21**: 625–708. 1934). The revised synonymy should read as follows:

HYMENOGASTER VISCIDUS Zeller & Dodge, Ann. Mo. Bot. Gard. **21**: 642. 1934.

Hysterangium viscidum Massee & Rodway, Kew Bull. Misc. Inf. **1898**: 127. 1898.

Protoglossum luteum Massee, Grevillea **19**: 97. 1891, fide Cunningham, Proc. Linn. Soc. N. S. Wales **59**: 169. 1934.

Hymenogaster luteus Cunningham, Proc. Linn. Soc. N. S. Wales **59**: 169. 1934, non aliorum.

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AN ANNOTATED CATALOGUE OF THE FLOWERING PLANTS OF MISSOURI[1]

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Preface

In 1886 Professor S. M. Tracy of the Department of Botany of the University of Missouri compiled and published a list of the native and introduced plants that had been collected or reported as growing spontaneously in the state. This work, entitled 'A Catalogue of the Phaenogamous and Vascular Cryptogamous Plants of Missouri,' listed 1785 species and varieties and constituted at the time a valuable contribution to the botanical knowledge and literature of the state. However, it was far from complete; little collecting had been done in numerous sections, and many of the records were taken from previously compiled lists or from verbal reports of local collectors, some of which proved to be unreliable or at least based upon erroneous determinations of material. For these rea-

[1] An enumeration of "The ferns and fern allies of Missouri," which may be considered supplementary to this catalogue, was published by the authors in the American Fern Journal **22**: 105–122. 1932.

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sons, as well as on account of the many changes in nomenclature and in the understanding of species, a considerable number of the plant names found in Professor Tracy's Catalogue do not appear in the present list. The total number of plants now recorded is, however, much larger, due to new discoveries and to the segregation of many species and varieties not recognized at that time.

Since the appearance of the Tracy Catalogue many sections of the state have been made accessible by the building of railroads, electric lines, and more recently of automobile highways, making it possible now for the collector to get into every county, even into the most rugged and thinly settled parts that were quite unexplored botanically at that time. An increasing number of students have become interested in the flora and have coöperated in making it better known through their work in different localities, and a considerable amount of literature, dealing wholly or in part with Missouri plants, has been published, all of which have contributed to a greatly increased knowledge of the state flora.

Perhaps the most noteworthy change has been in the methods of studying plants and in the attitude of students towards them. Fifty years ago plant catalogues and floras generally were little more than lists of species and genera arranged in families, and not much attention was given to plant associations, succession, ecology, or to the causes determining the distribution of plants and the development of floras, some understanding of which opens up one of the most interesting and significant fields of botanical investigation.

In the preface to his 'Catalogue' the only previous publications Tracy mentioned as sources of information were 'A Partial Catalogue of the Plants of Illinois and Missouri,' based upon collections of Mr. Geyer, and published by Dr. Engelmann in 1884; 'The Flora of Jackson County,' by B. F. Bush; and such general works as Gray's 'Manual of Botany,' and the government reports of King and Wheeler. He acknowledged notes, collections, and assistance received from Professor Swallow, State Geologist, Dr. Pech of Louisiana, Mo., Mr. Geyer, Dr. Engelmann, and others of St. Louis, Professor

G. C. Broadhead of Pleasant Hill, Mr. George W. Letterman of Allenton, Mr. B. F. Bush of Independence, Mr. B. T. Galloway of Columbia, and Professor Trelease of Washington University. Only a few other works dealing particularly with the flora of Missouri or containing references to it had appeared up to that time, and the list of other collectors, besides those mentioned by Professor Tracy, was not a long one.

One of the earliest scientific travelers to leave an account of his botanical observations in Missouri was Mr. John Bradbury, an Englishman who traveled extensively in America from 1809 to 1811. In the preface to the account of his journeys, published in Liverpool in 1819, he states that he arrived in St. Louis on December 31, 1809, and during the ensuing year made extensive excursions into the wilderness for a distance of 80 or 100 miles for the purpose of collecting plants. The following year he accompanied an expedition, in company with Thomas Nuttall, up the Missouri River and to the Pacific Northwest. There are references in his 'Journal' to a number of the trees and other plants observed along the river in Missouri, and at the end of the work there is a "Catalogue of some of the more rare and valuable plants discovered in the vicinity of St. Louis or on the Missouri."

It appears to have been the intention of Bradbury to publish a flora or a full list of his botanical collections, but this intention was not carried out for several reasons. Part of his collection was lost or damaged in transit to England, and his travels in America were cut short by the War of 1812. Upon his return to England he discovered that the part of his collection that had arrived safely had been submitted to Mr. Frederick Pursh, who had described a number of the new species in an appendix to his 'Flora Americae Septentrionalis.' Thus Pursh, who had traveled in other parts of North America but who had never been west of the Mississippi River, became the first botanical author to describe plants collected in Missouri.

In 1818 and 1819 Henry R. Schoolcraft made a journey through the almost unexplored Ozark region for the purpose of scientific study. He has left an interesting account of his

adventures and of the country, and although he was more concerned with the geology and other features of the natural history than with the flora, he mentions some of the trees and other plants, and his general description of the country gives us a valuable picture of it at that time.

About the same time Thomas Nuttall set out on his journey to the Arkansas Territory, traveling down the Mississippi to the mouth of the Arkansas River and making notes on some of the plants seen on the way. Nuttall's direct contributions to the study of Missouri botany are not large, but a number of Ozark species extending into the state from the south are mentioned or were first described by him.

Several of the early reports of the State Geological Survey contain references to the flora or give lists of trees and shrubs. B. F. Shumard, G. C. Swallow, and G. C. Broadhead were amongst the early state geologists who paid some attention to the flora, Broadhead collecting many plants in Cass County, where he lived, and in other parts of the state.

Amongst the more important lists of Missouri plants since the publication of Professor Tracy's Catalogue are a 'Catalogue of the Phaenogamous and Vascular Cryptogamous Plants in the Vicinity of St. Louis,' by Henry Eggert, 1891, 'A Manual of the Flora of Jackson County,' by K. K. Mackenzie and B. F. Bush, 1902, 'The Flora of Columbia and Vicinity,' by Francis P. Daniels, 1907, and a recent revision of this plant list by H. W. Rickett, 'A Preliminary Check List of the Cryptogams and Phanerogams in the Vicinity of St. Louis,' by members of the Engelmann Botanical Club, 1911, 'A Catalogue of the Plants of Jasper County,' by E. J. Palmer, 1916, and 'A List of Missouri Trees,' by F. Dunlap, 1929. Besides these there are numerous papers dealing with special families or genera of Missouri plants or with the flora or ecology of local areas, a complete list of which will be found in the bibliography.

In the process of working out the details of the flora of a large and diverse region such as the state of Missouri, it is unavoidable that certain parts should receive more attention or should become known earlier than others. This is partly due to differences in accessibility or nearness to centers of popula-

tion or to institutions of learning, and partly because certain students or collectors study the flora of the particular vicinity in which they live, while that of the rest of the state is investigated only sporadically by itinerant collectors, usually on hasty expeditions.

St. Louis, Jefferson, Franklin, Boone, Jackson, Jasper, and Greene counties seem to be the only ones in the state in which anything like an exhaustive study of the flora has so far been made. In several others extensive collecting has been done and the flora is fairly well known. Amongst these are Clark, Shannon, Dunklin, Butler, Atchison, and McDonald. There has also been considerable exploration in the counties of Ralls, Marion, Pike, Warren, Madison, Iron, St. Francois, Reynolds, Wright, Saline, Stone, Taney, Barry, and Newton, but many of the inconspicuous plants and probably some of the rare ones have never been collected or recorded. The flora of many of the other counties of the state appears to be quite inadequately known. On the whole, much more botanical work has been done in the area south of the Missouri River than in the northern part of the state, partly due to the fact that the Ozark region is more varied and contains many more rare plants. However, the counties to the north of the great river also hold much of botanical interest, and they would certainly repay a more intensive study. It is quite possible that a number of species of which the range is given as central and southern Missouri, because of lack of other records, will be found to extend also into the northern part of the state.

In this catalogue we have attempted to give the range within the state, so far as it is known, for each species, and also to note the type of soil on which it is usually found. The 114 counties of the state have been taken as convenient units for working out the distribution, and these are cited in addition to the general range for many of the less common plants or those confined to certain sections of the state. Common plants that grow in all parts of the state are listed as of general range, and in many cases they can be found in every county.

For the purpose of giving the general geographical range of species the state has been divided into three nearly parallel

zones of different width, which are called northern, central, and southern Missouri. Three zones are also recognized from east to west: eastern, middle, and western Missouri. However, since the east and west boundaries of the state are so irregular, it is not practicable to follow meridian lines, and a sketch map is given to show the general extent of these divisions. County lines are also irregular, and the entire county may be considered as belonging to the division in which the major part of it lies. In the case of a few counties that are approximately evenly divided by these lines, Reynolds and Crawford may be placed with eastern Missouri, Hickory with western Missouri, and St. Louis with central Missouri.

We have endeavored to bring the nomenclature up to date according to the International Rules, and in this we have followed the decisions of the Gray Herbarium for herbaceous plants and that of the Arnold Arboretum for woody species. No complete synonymy is attempted, but to aid the reader in locating unfamiliar names some synonyms are given, and where the name used is one that has not yet appeared in the general manuals, reference is given to the place of publication and in most cases to the name used in the seventh edition of Gray's 'Manual' (G), in the second edition of Britton and Brown's 'Illustrated Flora' (B & B), Rydberg's 'Flora of the Prairies and Plains' issued in 1932 (R), or in Small's 'Manual of the Southeastern Flora' issued in 1933 (S). The abbreviation Rh., which is frequently used, refers to 'Rhodora,' and auth. to author or authors. Other abbreviations for the titles of publications and for geographical names will be obvious, we believe, and most of those used for the names of authors may be found by consulting the list given in the seventh edition of Gray's 'Manual.'

Popular names of plants are of considerable interest both to botanists and laymen and those known generally or locally are given in this catalogue, but it has not been thought worth while to coin names nor to translate scientific ones. Some of the popular names are quite characteristic, and not all of them seem to have found their way into literature. Amongst examples of these are bodarc, chinquapin (oak), yanquapin,

sheep-sour, tonguegrass, and pursley. Any Missouri farmer, at least of an older generation, can tell you about his bodarc hedge—often pronounced "bodock," and evidently a corruption of the French *bois d' arc.* Chinquapin and yanquapin are

Fig. 1. Map of Missouri, divided into zones to show geographical range of species used in this catalogue.

of Indian origin, and the former, commonly used in some sections for *Quercus Muhlenbergii* without the additional word oak, is sometimes confused with the native *Castanea ozarkensis* found in the extreme southern part of the state, and to which

it properly belongs. The Missouri schoolboy or girl is familiar with sheep-sour and tonguegrass, although he might not recognize sheep sorrel and peppergrass. Likewise the thrifty housewife in search of spring greens can tell you the difference between narrow-leaf dock, which is good to eat, and broad-leaf dock, which is bitter, and she knows the excellent qualities of the young sprouts of poke-weed and lamb's quarter (not quarters). The farmer too knows his pursley or ''pusley,'' but only the city chap has heard of purslane. Crab-apple and not crab is the name given to the native species of *Malus,* and the woodsman might sniff at hearing a red haw called a thorn or a hawthorn as quickly as he would at the mention of a brook or a marsh, although he knows all about a branch or a slough. Old-man's-beard and Dutchman's pipe show the whimsical turn of mind, and there is a bit of slightly grim humor in such names as shin oak, beggar's lice, devil's claws, tear-blanket, and wait-a-bit.

The principal sources drawn upon in compiling this catalogue and in working out the distribution of species are, first, the collections in the herbarium of the Missouri Botanical Garden, the Gray Herbarium, the Arnold Arboretum, the National Herbarium for the grasses, and in some cases other public and private collections, including those of the University of Missouri, Columbia, the State Museum collection, Jefferson City, the herbaria, mainly local, of the following colleges: Central Wesleyan College, Warrenton; Cotty College, Nevada; Drury College, Springfield; Hannibal-Lagrange College, Hannibal; Missouri Valley College, Marshall; Park College, Parkville; State Teachers College, Springfield; and William Jewell College, Liberty; second, lists and monographs in which Missouri specimens are cited; and third, the unpublished notes and correspondence of the two authors, supplemented by notes and correspondence from other collectors. Free use has also been made of manuals and general works on botany, and these have been cited only where necessary for the sake of clearness, but a full list of the titles will be found in the bibliography. In addition to our previous work, extending in the case of the senior author over a period of thirty-five years, much intensive col-

lecting has also been done during the progress of this catalogue. In the summer of 1933 the authors spent several weeks together collecting in various parts of the state; and during the past three years the junior author has made several extended tours, visiting many counties where collections were especially needed to complete the records. As a result of these explorations a number of species not previously known in the state have been added to the flora; others have been found to extend into sections where they were not formerly known, and much valuable information has been secured in regard to the distribution and the composition of the flora in the different regions of the state.

There seems to be always a temptation in preparing lists and floras to make them as large as possible, and plants of doubtful occurrence or distinctness are often included. We have endeavored to avoid this error in the present catalogue and to follow a conservative course in admitting species. Many plants that have previously been reported as growing in the state have been omitted because we were unable to find specimens of them or to verify their occurrence. In some of the published lists, especially the earlier ones, species were reported that we now know to be quite foreign to our flora, and these errors in range have been copied repeatedly. It has been necessary to be on guard for such examples, and it is hoped that one result of this catalogue will be to dispose permanently of the report of plants that have been mistakenly included in the state flora.

In preparing the catalogue it has been found necessary to make a number of new combinations in plant names; one new species, three new varieties, and six new forms are also described, and names are proposed for four hybrid oaks. All new names and combinations are by the two authors, except where otherwise stated, as in the genus *Crataegus,* which is treated by the senior author.

While the two authors have cooperated and consulted with each other as fully as possible in the preparation of this catalogue, much of the work has had to be done individually and at two widely separated bases. This has necessitated a certain

division of labor and considerable independent investigation. The introduction and preface are largely the work of the senior author, the latter being in part a summary of an unpublished paper on the origin and distribution of the Ozark flora begun several years previously. He is also responsible for the revision of the genus *Crataegus* and has done most of the work on the other groups of woody plants. Most of the work of examining collections in herbaria other than that of the Arnold Arboretum has devolved upon the junior author, who has checked the large collections of Missouri plants in the herbarium of the Missouri Botanical Garden and has visited numerous other scientific institutions in the state and in other parts of the country, including the Gray Herbarium and the National Herbarium. In the course of this work he has found it necessary to question or change the determinations of many specimens and to eliminate a number of plants that had been credited to the state on misidentified specimens. The compiling of the bibliography of Missouri botany is also largely the work of the junior author.

Due recognition should be given to a number of collectors since the publication of Tracy's Catalogue whose assiduous efforts have contributed much towards extending our knowledge of the flora of Missouri. Amongst these are the late Henry Eggert of St. Louis, and G. W. Letterman of Allenton, who worked out so carefully the flora in the vicinity of St. Louis, as well as doing some work in other parts of the state; Mr. John H. Kellogg of St. Louis, who has carried on their work and extended it into many other counties, including particularly Franklin, Jefferson, Phelps, Texas, and Dent counties; Mr. B. F. Bush, the veteran collector and botanical author of Courtney, who in addition to his long study of the flora of Jackson County, has covered a wide field and done much towards making known the flora of the state; the late Rev. John Davis of Hannibal, who for several years industriously collected the plants of Ralls, Marion, and Pike counties, and also added new records from a number of other counties in the northeastern part of the state; the late Professor E. M. Shepard of Drury College, Springfield, who through his own collections and those of his students, especially Mr. Paul C. Standley

and Mr. J. W. Blankenship, helped make known the flora of Greene and several adjoining Ozark counties; and Dr. H. W. Rickett, Dr. Francis Drouet, and others of the botanical department of the University of Missouri, who are reviving an interest there in a state-wide study of the flora and in reorganizing the herbarium at the University of Missouri. The list might be further extended to include many others who have made local collections or botanical expeditions into various parts of the state.

We wish to express our sincere thanks to Mr. B. F. Bush, who has furnished us many records and specimens for examination. We are under obligation also to the curators and custodians of the botanical collections of the various colleges and museums of the state who have forwarded them to us for examination or placed them at our disposal. Our grateful appreciation is also extended to Mr. C. A. Weatherby, of the Gray Herbarium, for valuable assistance, to Professor Alfred Rehder, Curator of the Herbarium of the Arnold Arboretum, for advice on questions of nomenclature, to Miss Nell C. Horner, Librarian of the Missouri Botanical Garden, for her bibliographic assistance, and to Dr. George T. Moore, Director of the Missouri Botanical Garden, for interest shown in the work and for aid and suggestions.

Introduction

LOCATION AND AREA

Missouri lies somewhat east and a little north of the geographical center of the United States. The northern boundary of the state is along parallel 40° 30′ north; parallel 36° 30′ north forms most of the southern boundary, but a small section in the southeastern corner extends south to 36°. On the east the state is bounded by the irregular course of the Mississippi River, except for a short distance near the northeastern corner, where the Des Moines River separates it from Iowa. About two-thirds of the western boundary is a line running from the southwestern corner of the state to the Missourt River in longitude 94° 38′ west. North of this, the Missouri River, flowing in a generally southeasterly direction, forms the boundary.

The direct distance from north to south over most of the state is about 300 miles, but the southeastern corner extends 35 miles farther south. It is about 390 miles from the most easterly to the most westerly point in the state, but nowhere is the distance in a direct line so great. At the widest place near the southern border the distance is about 325 miles, while at the narrowest, from just above Hannibal to St. Joseph, it is scarcely 200 miles. It will thus be seen that the state extends farther from east to west than from north to south, although a contrary impression might be gained by a cursory glance at the map.

Compared with the Atlantic coast, the state lies approximately between the latitudes of Newark, N. J., and Norfolk, Va., or between those of Lisbon and Gibraltar in the Old World. The central and north-central parts of California parallel it on the Pacific side. The area of the state is 69,415 square miles, and it is therefore considerably larger than that of the six New England states.

Geographically, Missouri lies in the middle Mississippi valley and on the west bank of the great river. The states of Illinois, Kentucky, and Tennessee lie to the east, Iowa to the north, Nebraska, Kansas, and Oklahoma to the west, and Arkansas to the south. Thus it touches eight states, which is true of only one other state in the union, the neighboring commonwealth of Tennessee.

The state may be broadly described as an undulating plain rising gradually, or abruptly in places, from the Mississippi River towards the west and northwest, where it merges into the Great Plains. This plain is diversified by several pronounced features. On the east is the alluvial and recently formed valley of the Mississippi, varying from a narrow strip of sand and gravel at the foot of rocky cliffs to a maximum width of several miles of flood plain and fertile terraces. And across the state a little north of the center, the Missouri River has carved a similar valley, running irregularly, but mainly from west to east. Many of the larger tributaries of these two great rivers dissect the plain and divide the uplands with a network of alluvial bottoms of varying widths. The greater

part of southern Missouri is occupied by the northern part of the Ozark plateau, which is the most conspicuous and extensive relief feature between the two great mountain systems of the Appalachians and the Cordilleras. North of the Missouri River and west of the Ozark region, the plain is less diversified, and the rolling surface, interrupted only by the usually shallow valleys of the streams, rises gradually and rather uniformly towards the northwest. Finally, in the southeastern corner, abruptly separated from the Ozark plateau, there is a small area of low relief, which is a northward extension of the Coastal plain. Thus, three principal physiographic regions, the Southeastern lowlands, the Ozark region, and the Prairie region, may be recognized in the state, and since the boundaries of the main plant provinces correspond generally with these, it will be worth while to describe them in some detail.

ELEVATION AND DRAINAGE

The rise in the elevation of the land surface from the level of the Mississippi River is very irregular. In the Southeastern lowlands the altitude above tide level over most of the area is between 280 and 350 feet, and the generally level surface is relieved by only one slight elevation along Crowleys Ridge, in Dunklin, Stoddard, and Scott counties. This reaches a maximum height of about 450 feet. In the Ozark region the rise is generally abrupt, and the river, except sometimes for a narrow strip of valley, is bordered by precipitous bluffs. In the Iron Mountain sub-region, about 75 miles west of the river, the surface rises in many places to over 1,000 feet above tide level, and the altitude of the highest points at Tom Sauk and Wild Cat Mountains is approximately 1,800 feet. Most of the area of the Ozark uplands farther west has an elevation of between 1,000 and 1,300 feet and it reaches a maximum of slightly over 1,700 feet in Wright County. On the northern and northwestern sides there is a gradual falling off towards the valleys of the Missouri and Osage rivers. Between these two streams a local area in Morgan County again rises to over 1,000 feet, and in Barry County, near the southwestern corner of the state, the highlands reach an altitude of over 1,500 feet. In the

Prairie region, north of the Missouri, the altitude rises from about 600 feet in St. Charles County to a little over 1,200 feet at the northwestern corner of the state.

The drainage of the entire state is into the Mississippi-Missouri River system, but the considerable differences in elevation and in the hardness and strike of the underlying rocks, and other features of its complex topography have caused the tributary streams to run in various and sometimes circuitous directions before reaching the great rivers. In the northern part of the state the general direction of the streams is southward into the Missouri River, except along the eastern quarter, where they flow mostly southeast into the Mississippi. Most of the streams of the Prairie region are slow-flowing or somewhat sluggish, and in very few places have they developed bluffs or banks more than a few feet high. This is due to the generally soft character of the formations through which they have worn their channels, which is usually glacial drift or Pennsylvanian sandstones and shales. None of the streams in this part of the state attain much size, the largest being the Grand and Chariton rivers.

South of the Missouri River, the drainage from the Ozark plateau, where nearly all of the streams have their sources, is in various directions. In the southeastern part and to beyond the center of the state along the southern border, most of them have a generally southerly course. The St. Francis, Black River, Current River, and the North Fork of White River are the most important streams in this area.

Along the northern side of the plateau the Meramec flows northeast, east, and finally southeast before reaching the Mississippi; the Gasconade and its tributaries flow north and northeast into the Missouri, and the Osage, the largest tributary of that river in the state, flows in a circuitous course, in the main eastward and along the northern side of the plateau, before joining it a little east of the center of the state. In its eastward course the Osage captures a number of north-flowing streams.

White River, one of the larger tributaries of the Mississippi, which has its sources in the Boston Mountains of western

Arkansas, through a great curve to the north flows for a short distance through southern Missouri, in Barry, Stone, and Taney counties, before again turning southeast to cut its narrow valley through some of the most rugged parts of the southern Ozarks, and finally to emerge into the broad lowlands and to join the Mississippi far to the south in Arkansas. In Missouri it receives one large tributary, the James River, and several smaller ones from the north. The influence of this stream on the flora is very great, as it seems to have been the gateway by which many plants from the southwest and others from the southeast have entered.

In the southwestern corner, in the counties of McDonald, Newton, Jasper, and the southern part of Barton, the drainage is westward through Spring River, Shoal Creek, and Elk River, which join the Neosho farther west; and through that stream their waters find their way into the Arkansas and finally into the Mississippi. The direction of these streams has also had an influence on the flora, which is evident in the presence of many species from the Southwest in the area which they drain.

Many of the Ozark streams have their sources in large springs, and the majority are fed by springs along their courses. Most of them are perennial, but often when not at flood stage the water may disappear under the beds of coarse gravel and boulders for some distance, only to emerge again where a ledge of solid rock comes to the surface. Usually they are swift-flowing and subject to rapid rises, sometimes with disastrous results after heavy rains. Only the larger ones have reached the stage of forming alluvial valleys. These are usually bounded by precipitous bluffs, and on one side or other of the valley the stream in its meanderings will often closely approach one of these. Narrow V-shaped valleys and cañons are common along the smaller streams in the more rugged parts of the region, and these, as well as the high bluffs, afford protection to many rare plants, which are generally species of northern range or of the southern Appalachians, although in some situations they are plants of southwestern distribution. The meandering courses of many of the Ozark streams, and sometimes their general direction for considerable distances,

seem to have been influenced or determined by differences in the hardness of the rocks, or by the structure and pitch of the strata through which they have cut their channels, and in some cases there is evidence that their original courses have been much changed or reversed by geological forces during the last cycle of elevation of the region.

All the streams that flow through the Southeastern lowlands have their sources in the Ozark plateau, but in their lower courses they are sluggish, with scarcely defined valleys, and they are often bordered with wide swampy areas. Ox-bow bends and shallow bayous, sometimes widening into shallow lakes, are frequent along their courses, and before the present system of artificial drainage was inaugurated, in times of flood their waters spread over almost all of the area, often rising to a height of two or three feet on the trunks of the forest trees. Such conditions naturally had a marked effect upon the flora, completely inhibiting many species and restricting others to the low ridges and knolls, while favoring aquatic and palustral plants, which formed a large percentage of the flora.

CLIMATE

The climate of Missouri, like that of all the central Mississippi Valley, is marked by great extremes and is subject to sudden changes of temperature. Cyclonic storms and occasionally destructive tornadoes, the latter generally very local, occur throughout the spring and summer months. These sometimes terminate periods of extreme heat and humidity, and are followed by longer intervals of mild pleasant weather. The storms are frequently attended by electrical discharges and by rain, which falls in torrential quantities; and there is sometimes also hail, that may do great damage over limited areas. The winters are generally mild and open for the most part, but they are interrupted by occasional severe storms or "blizzards" that originate in high altitudes and sweep down across the plains, bringing sudden drops of temperature, sometimes of 30° or 40° or more in a few hours. The total annual rainfall averages from 40 to 45 inches over the southern part of the state, and it diminishes to 30 or 35 inches in the northwestern

part. However, it is often too unevenly distributed throughout the season to be of the greatest value to plant life. Most of it falls during the spring and early summer months, and there is sometimes a short rainy season in September or October; but protracted droughts, that often occur in the late summer and sometimes earlier, have a destructive or limiting effect upon many plants. And this is one of the causes for the absence of some species found in similar or more northern latitudes nearer to the coast or where more equable conditions prevail.

The direction of the winds is quite variable. In the spring and summer the prevailing direction is from the south and west, and in the autumn or winter it is often from the north or northwest. Although the severe winter storms come from these directions, the west and northwest winds of summer are often hot and dry and at other times storm-laden, while those from the south, which originate in the Gulf-Caribbean cyclone center, because of the distance and the altitude at which they travel, are usually cool and refreshing. The east winds of spring and early summer are frequently chilly and damp. In the spring and fall months the winds are often strong and blow steadily, sometimes for several days.

The winds influence the flora in several ways. As carriers of moisture or as agents in its evaporation, their effects are most important. The strong dry winds are at least one of the factors that have prevented the spread of forests and have kept the western plains and prairies as open grass lands. They are also an important agency in the transportation of seeds, and as an erosive force and as carriers of soil, dust, and sand, their effect, though not so conspicuous as in drier or more sandy regions, is by no means negligible. The generally small size and stocky character of the trees on open uplands is at least in part due to the strong winds.

The winter and early spring blizzards are generally accompanied by snow or sleet. The amount of snowfall varies greatly in different years. Some winters pass with only a few light snows, aggregating not more than two or three inches in thickness, while at rare intervals there may be a season in which there are repeated falls, and in small areas in more

northern parts a maximum of two or three feet on the level is sometimes formed. Memory of such exceptional seasons gives rise to the popular belief in a changing climate and to the tradition of the "old-fashioned" winters. Snows generally melt rapidly, but when they remain on the ground for some time they have a favorable influence upon vegetation, especially upon grasses and herbaceous plants. One of the most unfavorable climatic influences upon the flora in Missouri is the comparatively late dates at which killing frosts occur. Sometimes these come as late as the first week in May, and their effect then upon tender plants is most disastrous, often destroying the fruit or the entire plant for the season and in some cases killing them outright. This has probably been one of the most effective barriers to the northward spread of many tender or less hardy species.

The influence of climate upon the vegetation is very great, and climatic conditions operating in the past have doubtless been one of the principal factors in determining the present composition of our flora. Rich and varied as the flora of Missouri is, its diversity is due largely to other causes, such as the variety of soils, drainage, exposures, or protection afforded in different localities. For it is the extremes of moisture and temperature and not the averages that affect tender plants and work destruction upon them, and the temperatures occasionally recorded in Missouri winters are lower than those on the Atlantic coast far up into New England. The long severe droughts also prevent the spread of many mesophytic or hydrophytic species, limiting them to restricted areas or entirely excluding them from the region. Also the torrential rains and resulting floods in the stream valleys cause rapid erosion on steep slopes and prevent the accumulation of soil in rocky areas, as well as submerging large tracts of lowlands for considerable periods.

The following tables showing the average and the maximum and minimum temperature and rainfall by months, taken from the records of the United States Weather Bureau, will illustrate some of the extremes of climate in Missouri.

CLIMATE OF COLUMBIA, BOONE COUNTY, MISSOURI
(41 YEARS' RECORD)*

Elevation above sea level 784 feet.

MONTH	Mean temp. F.°	Mean max. F.°	Mean min. F.°	Mean rainfall inches	Average snowfall inches	Prevailing winds from
December	33	42	24	1.86	3.8	SW
January	29	39	20	1.92	5.3	S
February	32	41	22	2.04	6.0	NW
Winter	31	41	22	5.82	15.1	SW
March	43	54	33	2.94	3.7	S
April	55	65	44	3.77	0.5	S
May	64	75	53	4.46	T	S
Spring	54	65	43	11.17	4.2	S
June	73	83	62	4.76	0	S
July	77	88	66	3.49	0	S
August	76	87	65	3.60	0	S
Summer	75	86	64	11.85	0	S
September	68	80	58	4.35	0	SE
October	57	69	46	2.61	0.1	S
November	43	54	34	2.20	1.0	S
Autumn	56	68	46	9.16	1.1	S
YEAR	54	65	44	38.00	20.4	S

Highest temperature in 41 years, 111; lowest in 41 years, –26.
Average date last killing frost in spring, April 13.
Average date first killing frost in autumn, October 18.
Latest date killing frost in spring, May 9.
Earliest killing frost in autumn, September 18.
Average length growing season (K-frost to K-frost), 188 days.
Average annual number of days with 0.01 inch rain or more, 113.
Average number days 0.01 inch or more rain, April to September, 64.
The wettest year of record, 1892, with 54.62 inches.
The driest year of record 1901, with 21.35 inches.
The wettest single month, June, 1928, with 14.86 inches.
The driest single month, August, 1909, with 0.06 inch.
Average wind velocity, January 9 miles; February 10 miles; March 10 miles; April 10 miles; May 8 miles; June 7 miles; July 7 miles; August 7 miles; September 7 miles; October 8 miles; November 9 miles; December 9 miles. Annual 8.
Wind velocities of 32 miles per hour or more, about 2 a year.
Wind velocities of 47 miles per hour or over, about 1 in 10 years.
Highest velocity ever recorded for a period of 5 minutes, 50 miles. Extreme velocity for one minute, 57 miles per hour.
The greatest known depth frost penetrated the ground, 36 inches.
Authority for ground frost penetration city engineers, grave diggers, and telephone-hole diggers.

* Furnished by the United States Weather Bureau Office.

GEOLOGY AND TOPOGRAPHY

Since plants grow in and are entirely dependent upon the soils, it is important to consider them and the rock formations from which they are derived in a general study of the flora. Moreover, clues to many perplexing facts in regard to the present distribution of native plants can often be found only in the past geological history of the region as well as in a study of its present topography and ecology.

All of the state of Missouri, with the exception of the Southeastern lowlands, has been above sea level since late Paleozoic time. Parts of the Ozark region are amongst the oldest lands on the continent, the Archaean and Algonkian rocks of the Iron Mountain sub-region having been a part of the original land axis of North America. The Iron and St. Francois Mountains in the southeastern part of the state are remnants of an old system, the peaks of which doubtless once stood much higher than they do at persent, and the granitic and porphyritic rocks of which they are composed have during ages of erosion furnished material for the formation of the sedimentary beds which were later laid down in the seas about their bases. They may at one time have been entirely submerged and buried by sediments from higher land areas, and they are now in the process of being excavated by erosion. About this nucleus, beds of sandstones, limestones, and dolomites, and less generally of shales and conglomerates, were being formed in concentric bands and in overlapping layers down to the close of the Carboniferous or the beginning of the Permian period, when the whole region was gradually uplifted above sea level.

Although no traces of them now remain, we can safely assume that the earliest forms of land plants once occupied this region, and that the whole long pageant of the development of plant life has passed in review here. The luxuriant fern forests of the Coal period flourished in the lowlands and marshes bordering the seas, as the abundant fossil relics found in many places bear witness, and as the higher classes of flowering plants appeared at least in the Cretaceous and succeeding ages they found in the Ozark region a land surface already old

and with a diversity of soils and ecological conditions suited to a varied flora. So our present flora has an ancient lineage, and there is reason to believe that many of the rarer plants found isolated in parts of the region may have survived from remote times.

During the Cambrian and Ordovician periods most of the present area of Missouri was covered by seas of varying depths. Thick beds of magnesian limestone or dolomite were deposited in the deep seas and sandstones nearer the shores. These deposits now lie deeply buried under later strata over most of the state, but they come to the surface over much of the Ozark region. Narrow belts of Silurian and Devonian limestones and shales are found along the eastern and northeastern sides of the present Ozark plateau, and more locally to the west and southwest, but most of the region seems to have been a land surface during those times. Stratified rocks of the Mississippian series, mostly pure limestones with interbedded chert and some more local beds of sandstone and shale, also encircle the Ozark plateau in a wider belt, coming to the surface over considerable areas in northeastern Missouri and in the west-central and southwestern parts of the state. Farther north, as well as west, and eastward beyond the borders of the state, they are buried beneath the sandstones and shales of the Pennsylvanian series. The shallow seas of the late Carboniferous period probably at one time covered nearly the entire state, as outlying areas of the rock deposits are found in many parts of the Ozark region, though in most places they have been removed by subsequent erosion. But over most of northern Missouri and south of the Missouri River on the western side of the state they come to the surface, except where buried under transported glacial material. Limestones formed in the more open seas at this time are also found in some places.

Nearly all of Missouri was a land surface undergoing erosion through the middle ages (Mesozoic) of geologic time, although there were probably considerable changes of level during the late Cretaceous, when igneous rocks were being thrust up in the Ouachita Mountain region of central Arkansas. At that

time the waters of the Gulf of Mexico came up to the southeastern border of the present Ozark region, and deposits made along the shores come to the surface in Scott and Stoddard counties in parts of Crowleys Ridge in the southeastern Missouri lowlands.[2] The upward movement of land surfaces at that time probably affected the drainage of the entire region and changed the directions of many streams. The upper Mississippi River may not have assumed its present course until about this time.[3]

The Mississippi Embayment of southeastern Missouri remained until a much later time, at least until the last elevation of the Ozark region, towards the close of the Tertiary period. The Southeastern lowlands now occupy the area of this old embayment. Prior to this time the surface of the Ozark uplands was being worn down until most of the region was reduced to a low, comparatively level plain, with sluggish streams and probably large areas of swamps, covered with a forest in many respects similar to that which now occupies the Southeastern lowlands. The probably slow and long-continued movement that again elevated the region resulted in a rejuvenation of the streams, which, because of the steep grades, began cutting new valleys and producing the rough topography that is now found especially along the steep slopes of the dome.

The cold climate and the several southward movements of the polar ice sheets during the Pleistocene period must have profoundly affected the flora of the entire northern and central United States. In Missouri during the Kansan epoch, one of the earliest advances of the ice, the ice sheet covered a large part of what is now the Prairie region north of the Missouri River, bringing down from the north great quantities of gravel and boulders, mostly of igneous and metamorphic rocks such as are not found in place nearer than Minnesota, the Dakotas, and Canada. As the ice melted and retreated the region it had

[2] Matthes, F. E. Cretaceous sediments in Crowleys Ridge, southeastern Missouri. Bull. Am. Assoc. Petrol. Geol. 17: 1003–1009. 1933; also Farrar, W. The geology and bleaching clays of southeast Missouri. Part I. The Cretaceous and Tertiary Geology. Mo. Geol. Surv. Bien. Rept. Appendix I. pp. 7–20. 1935.

[3] Marbut, C. F., Physical features of Missouri. Mo. Geol. Surv. 10: 76. 1896.

covered was left with these, as well as a deep mantle of soil and clay, the result of the grinding and pulverizing of the rocks over which it had passed. Later, much of this material was taken up and redistributed over wider areas by the waters of the flooded streams. The ice sheet may have come as far south at this time as Clinton, Carroll, and Randolph counties.[4] In the later Iowan epoch the ice seems to have again advanced to just within the northern borders of Missouri.

The thick deposits of loess, which are so conspicuous above the bluffs of the Missouri River from Atchison County to below Kansas City and which also occur along the Mississippi River on the eastern side, were probably deposited in shallow lakes or sluggish streams during this time of the retreating ice.

The most recent effects of geological forces in the state can be seen in the alluvial valleys of streams, in eroded surfaces and ravines that result from every flood, and in the cumulative effects of frost, wind, and rain, all of which go on every year, modifying the surface of the land and influencing the vegetation.

The present topography and surface geology of the state is the result of this long geologic history, every cycle and change of which has had its influence in determining the present character and distribution of the flora.

Some plants are restricted to special kinds of soil and others show a preference for certain ones. And since most of the soils in Missouri, except over the glaciated areas of the Prairie region and in the alluvial valleys of streams, are residual and have resulted from the breaking down of the local rocks, the relation between the underlying geological formation and the plants that grow above them is often very close.

Plants that grow on alkaline soils, or those containing a large percentage of lime, are called calciphiles. Soils and plants of this class are usually found in limestone areas. Acid or subacid soils, deficient in lime, are generally found in areas where

[4] Todd, J. E., Formation of the quaternary deposits of Missouri. Mo. Geol. Surv. **10**: 213. 1896.

sandstones, cherts, and other siliceous or granitic rocks come to the surface. But acidity may result locally from other causes, and in the Ozark region this type of soil is often due to the leaching out of the lime and the accumulations of chert that was originally present as lenses or nodules in the limestone strata, or to the concentration of magnesium in dolomite areas. Plants that grow on acid soils are called oxylophiles, but most plants are not absolutely restricted to one type of soil, though showing a more or less decided preference for it. Another group of plants, including by far the greatest number, are found on soils of not too pronounced a character, but which may be either neutral, sub-acid, or sub-alkaline. Such plants are described as circumneutral. Others, such as many of the common weeds, grow on almost any sort of soil, where other conditions are not too unfavorable, and these are said to be indifferent.

The Flora

In its broadest sense the term flora embraces all forms of vegetation found within a region, including, besides the higher or flowering plants, mosses, lichens, fungi, algae, and other less conspicuous and microscopic groups. But it is generally used in a much more restricted way, and in speaking of the flora most writers and students have in mind only the more conspicuous groups of the phanerogams and vascular cryptogams, and it is in this sense that the term is used in this catalogue.

The character of the vegetation in any region is determined by the physical conditions, and the requirements of different sorts of plants vary widely. Some grow directly in water or require a constant and abundant water supply; others grow in drier situations or can live only in places that are usually very dry and well drained. Some require shade or the support or protection of other species; and some thrive only with abundant light and sunshine. Many forms of vegetation are very sensitive to frost and cold and are limited to tropical or subtropical regions; while others, through long periods of dormancy, have become inured to severe cold. Within every region

of any considerable extent a wide variation in many or all of these conditions is found, giving opportunity for plants of different requirements within certain limits to find a place in the flora. But the limits of a region and its flora are defined more or less sharply by physical barriers or by differences in ecologic conditions. Climatic zones of temperature or rainfall, geographic barriers, such as oceans, high mountain ranges, deserts, or wide river valleys, or sudden changes in the character of the soil or drainage, are amongst the things that often determine the boundaries of floras. Some of these barriers, however, are not absolute. The effect of climate asserts itself only gradually and in different degrees upon different sorts of plants, so that the boundaries between different floras or subdivisions of floras are generally not sharp and clear, but there is a border line along which one merges into another. This is particularly true when speaking of the flora of a limited area.

In considering the flora of Missouri, it should be remembered that it is only a part of the flora of eastern and middle North America, and that while several different plant regions can be recognized within the state, the boundaries between none of them are absolute, and that the range of many species extends from one region to adjoining ones and often throughout the entire state. But at the same time each of the principal plant regions, and to a less extent each subdivision of them, is distinguished by the presence of a number of species restricted to it, and by certain characteristics in the type and composition of the flora.

PLANT REGIONS

The principal plant regions of the state, corresponding in general to the physiographic regions previously described, are the Southeastern lowlands, the Ozark region, and the Prairie region, but the boundaries of the physiographic and phytogeographic regions are not quite identical. In places the flora of the lowlands pushes for short distances up the river valleys into the Ozark plateau, and the flora of the latter extends northward beyond the plateau and is the dominant element along the

bluffs north of the Missouri River and on the hills bordering that stream as far west as the mouth of the Chariton. On the western side it also occupies the river bluffs and rocky uplands in what is mainly the Prairie region, while, on the other hand, wedge-like extensions of the prairie flora penetrate the Ozark region, and colonies of prairie plants occupy glades and openings in the forest.

Lists of characteristic plants are given after the description of each of the plant regions. These are intended to include such species as are wholly or mainly confined to the region, and many of the most common and conspicuous plants may not be mentioned because of the fact that they are equally common in other regions.

SOUTHEASTERN LOWLANDS REGION

In the Southeastern lowlands there are no outcrops of solid rocks except a few outlying remnants along the border of the Ozarks. Much of the soil has been transported as alluvium by streams, and in places it has been enriched by humus from the decay of the forests. In other parts it has become acid through leaching, lack of drainage, or the influence of the decaying vegetation. On some of the slight elevations the soil is sandy, and this may have been washed down locally into depressions, forming sandy bogs or bayous, with an acid-loving type of vegetation. Most of the soils in this region are either sub-acid or neutral, with areas of a definitely acid type and others that are mildly alkaline. The drainage is generally poor, except on Crowleys Ridge, and although there are many plants here not found in other parts of the state, the flora is rather uniform over most of the region. The characteristic and dominant plants are those of the Gulf Coastal Plain, and the region as a whole is Lower Austral, and with the southern phase of the Carolinian flora.

Nearly all of the region was originally forested with a dense and luxuriant growth of deciduous trees. In the swampy or more frequently inundated areas, bald cypress, tupelo *(Nyssa aquatica)*, pumpkin ash *(Fraxinus profunda)*, red maple, swamp hickory, water locust, swamp cottonwood *(Populus*

heterophylla), water elm *(Planera aquatica)*, overcup oak, itea, button-bush, and a few other trees and shrubs are dominant.

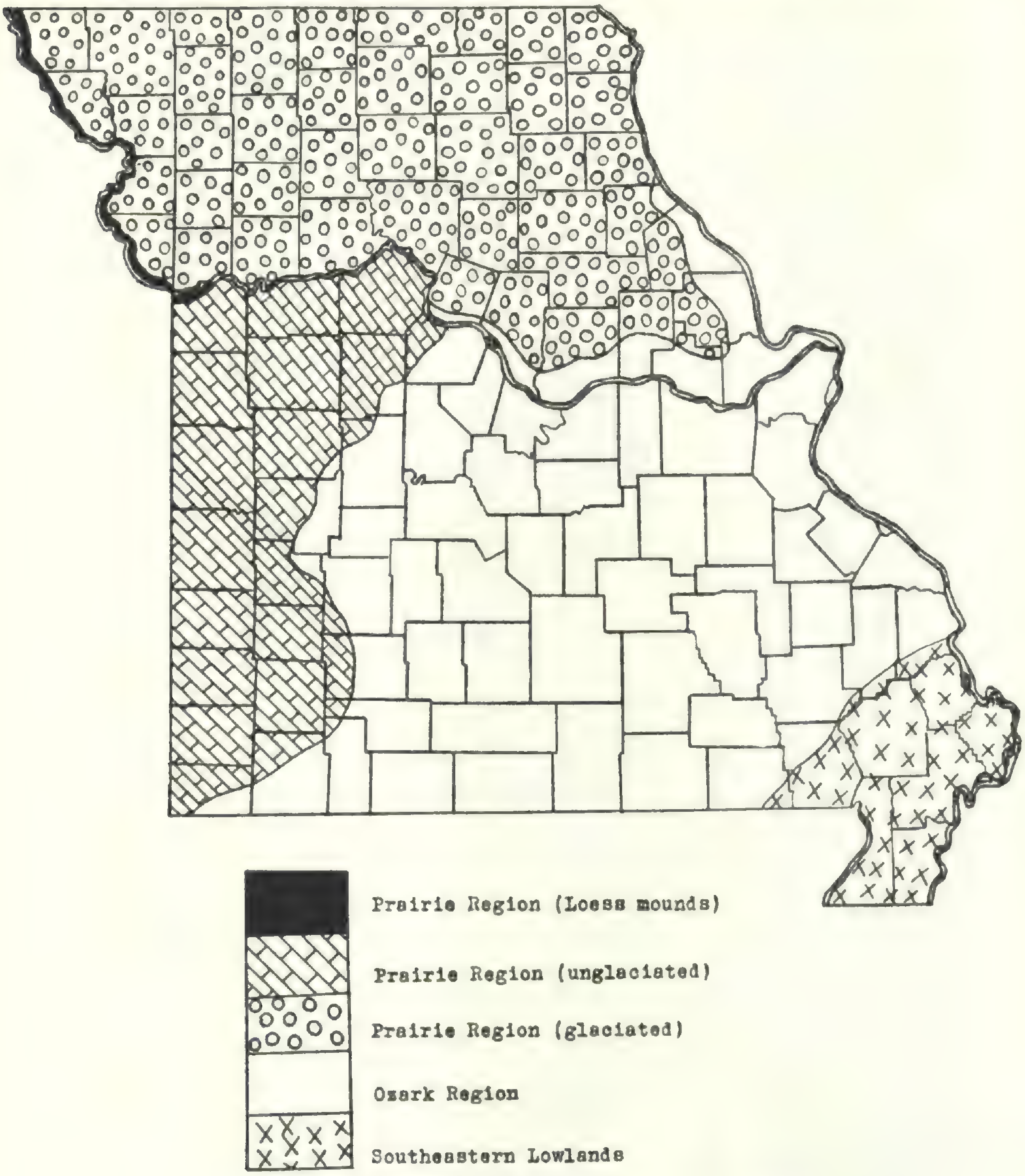

Fig. 2. Map of Missouri, showing the plant regions.

There are comparatively few herbaceous plants except aquatics, although coarse sedges and grasses and some others grow along the margins of the sloughs and swamps. On the

slightly higher ground above the flood stage, or where it is seldom inundated, the flora is much richer in species. The forest here contains many sorts of oaks, white hickory, sweet gum, black gum, winged elm, white ash, flowering dogwood, and other trees, besides a variety of shrubs and vines and a large array of herbaceous plants. Yellow pine *(Pinus echinata)* is found rarely on the higher sandy ground, but there are no other conifers and seldom any ericaceous plants. Most of the forest species found on the drier parts of the lowlands are also found on Crowleys Ridge, and growing with them are many others that are practically restricted to this elevation in the region. Some of the latter are species of distinctly eastern or northeastern distribution which are near their western limits here, at least in this latitude. Beech, Spanish oak *(Quercus falcata)*, tulip-tree, cucumber-tree, sweet gum, linden *(Tilia glabra)*, and sugar maple are amongst the commonest forest trees, and the scarlet oak and beaked hazelnut are also rarely found. Geological evidence indicates that Crowleys Ridge lay to the east of the Mississippi River until comparatively recently, when the channel of the river changed, and the flora would seem to lend support to this.

The flora of the Southeastern lowlands, with the exception of the eastern element found on Crowleys Ridge, is probably a very ancient one. Except for the loss of some of its more tropical species, it may have changed only slightly since middle or early Tertiary time, when it extended far beyond its present limits. In Missouri it probably occupied the lowlands to the north and west before the elevation of the Ozark plateau, where traces of it are still to be found, and it may have covered most of the state before the incursion of the northern ice sheet.[5]

[5] Evidence is rapidly accumulating that seems to make it necessary to revise the ideas previously held as to the intensity of the cold that accompanied the advance of the glaciers in the Quaternary era, and of its completely destructive effects upon the flora. It now seems more probable that fragments of the forest and associated herbaceous flora continued to flourish in parts of the generally glaciated regions, especially toward the southern limits of the ice, although doubtless losing many of the less hardy species. Similar conditions are found today in regions where glaciers are present and where a varied flora is sometimes found growing almost up to the edge of the ice.

Fossil remains of the bald cypress, which now reaches its northern limits here, have been found in Tertiary and Pleistocene deposits over a large part of North America, reaching as far north as the St. Lawrence valley. And other fossil as well as living plants prove the former wide extent of this southern flora. The physiography of the Ozark region and of regions surrounding it was at that time very different, and it has since also undergone great climatic changes in the course of which plants have invaded the region from different directions. But it is interesting to find that a number of species which are generally of coastal distribution and that are now mainly confined to the Southeastern lowlands in Missouri reappear in isolated stations far up the Mississippi River and sometimes in remote parts of the Ozark region. The most extensive colonies of such plants are along White River and its tributaries, and some species extend to the western boundaries of the state. As the White River country belongs to the Ozark region, of which it is a rather distinct subdivision, it will be described later, but a few examples of the extension of lowland species into other parts of the state may be mentioned here.

The green haw (*Crataegus viridis*) is a common species throughout the Coastal plain from Virginia and Florida to eastern Texas, and in Missouri it is abundant in wet woods in the Southeastern lowlands. But it also extends up the Mississippi and Missouri Rivers to Marion and Cole counties, and it is found in the valleys of some of the other larger streams across the southern part of the state, and northward again along the western side of the state to the Marais des Cygnes bottoms in Bates County. Although usually a species of low or swampy woods, it is found both in northeastern Missouri and in the southwestern part of the state, on high limestone hills where there is an abundant supply of seepage water along the ledges in rainy seasons. *Rhamnus caroliniana* and *Ilex decidua,* both of which have a general range similar to that of the green haw, also have much the same range as that species in Missouri, although the former does not extend quite so far north. And it is an interesting fact that all of them have

adapted themselves to the same unusual conditions in the limestone areas. *Forestiera acuminata* is another lowland species, although its general range is more southwestern, that in Missouri extends from the Southeastern lowlands up the Mississippi River to Pike County, and in isolated stations westward along White River and Spring River in Jasper County. *Quercus lyrata* and *Trachelospermum difforme,* typical Coastal Plain species, besides being common in the Southeastern lowlands, are found locally in St. Louis County. *Ampelopsis arborea* extends north to Jefferson and St. Louis counties, and *Gleditsia aquatica* is also found in the former county. *Hottonia inflata* has been collected in St. Louis County, and *Mitchella repens* as far north as Lincoln County. The pubescent form of the sugar maple, *Acer saccharum* var. *Schneckii,* which has a well-defined range in the lowlands of the central Mississippi Valley, including southeastern Missouri, has been found in an isolated locality in Benton County. Other southern plants that apparently skip across the state from the Southeastern lowlands to the drainage basin of Spring River in southwestern Missouri are *Paspalum floridanum, Scirpus carinatus, Agalinis viridis, Mecardonia acuminata,* and *Pluchea petiolata.*

The unusual distribution of some of these plants may possibly be accounted for on the theory of recent extensions of range, but in the case of some of those which are found over such wide areas, as well as of others found in the White River sub-region, it seems more reasonable to believe that they are survivals from a former more general distribution in the region and examples of successful adaptation to changing conditions.

The Southeastern lowlands is the most distinct plant region in the state and its flora is the most uniform. But in recent years lumbering, drainage, and cultivation have worked widespread destruction upon the native flora, and it is rapidly losing its distinctive character, while many of the plant species seem doomed to early destruction here.

CHARACTERISTIC PLANTS OF THE SOUTHEASTERN LOWLANDS REGION

Woodwardia areolata
Botrychium dissectum var. *tenuifolium*
Taxodium distichum
Sagittaria platyphylla
Echinodorus radicans
Panicum hians
Arundinaria gigantea
Cyperus Gatesii
Cyperus compressus
Cyperus dipsaciformis
Rynchospora macrostachya
Carex cherokeensis
Carex Joorii
Carex oxylepis
Carex louisianica
Wolffia papulifera
Wolffiella floridana
Smilax glauca var. *leurophylla*
Smilax rotundifolia var. *quadrangularis*
Hymenocallis occidentalis
Iris fulva
Thalia dealbata
Populus heterophylla
Leitneria floridana
Carya aquatica
Quercus Prinus
Quercus lyrata
Quercus nigra
Quercus Phellos
Quercus Nuttallii
Quercus falcata
Quercus falcata var. *pagodaefolia*
Planera aquatica
Phoradendron flavescens
Polygonum densiflorum
Brunnichia cirrhosa
Cabomba caroliniana
Ranunculus pusillus
Itea virginica
Liquidambar Styraciflua
Crataegus Marshallii
Rosa palustris
Gleditsia aquatica
Cassia Tora
Cassia occidentalis
Wisteria macrostachya
Sesbania macrocarpa
Amorpha croceolanata
Croton Engelmanni
Crotonopsis linearis
Ilex opaca
Evonymus americana
Acer floridanum
Acer rubrum var. *Drummondii*
Aesculus discolor var. *mollis*
Sida Elliottii
Vitis rotundifolia
Vitis palmata
Hypericum petiolatum
Hypericum virginianum
Viola lanceolata
Rhexia mariana
Jussiaea decurrens
Ludvigia glandulosa
Aralia spinosa
Eryngium prostratum
Cynosciadum digitatum
Steironema radicans
Cornus femina
Nyssa aquatica
Bumelia lycioides
Styrax americana
Fraxinus profunda
Fraxinus profunda var. *Ashei*
Polypremum procumbens
Trachelospermum difforme
Asclepias perennis
Asclepias variegata
Hydrolea ovata
Hydrolea affinis
Lippia nodiflora
Agalinis heterophylla
Veronica serpyllifolia
Bignonia capreolata
Dianthera ovata
Diodia virginiana
Cephalanthus occidentalis var. *pubescens*
Oldenlandia uniflora
Cayaponia grandifolia
Lobelia puberula

Mikania scandens
Eupatorium incarnatum
Eupatorium cuneifolium var. *serratum*
Solidago suaveolens
Solidago leptocephala
Spilanthes americana var. *repens*
Gaillardia lutea
Helianthus angustifolius
Pluchea foetida

CHARACTERISTIC PLANTS OF CROWLEYS RIDGE IN SOUTHEASTERN LOWLANDS*

Erianthus strictus
Carex nigro-marginata
Corylus cornuta
Fagus grandifolia
Fagus grandifolia var. *caroliniana*
Liriodendron Tulipifera
Magnolia acuminata
Stylophorum diphyllum
Hydrastis canadensis
Actaea brachypoda
Ribes Cynosbati
Malus ioensis var. *spinosa*
Nemophila microcalyx
Hydrophyllum canadense
Blephilia ciliata
Pycnanthemum incanum
Fraxinus biltmoreana
Catalpa speciosa
Epifagus virginiana
Mitchella repens
Helianthus microcephalus

* It will be noted that several species of this list are of wider range in other regions of the state, but they are practically restricted to this part of the lowlands.

THE OZARK REGION

Magnesian limestones and sandstones are the surface rocks over a large part of the Ozark region. The strata are usually horizontal or only slightly tilted, although in places there are local faults and disturbances. Chert, which is associated with the magnesian limestone in many places, often covers the uplands as a residual deposit after the less resistant limestone has been removed by erosion or solution. The magnesian limestone or dolomite produces an alkaline soil except where an unusual amount of magnesium is present or where the lime has been leached out on exposed slopes. In such places, as well as on the cherty uplands, the soil may be more or less acid.

The sandstones, of which the Roubidoux and St. Peter are the most important, outcrop along bluffs and ledges and locally over more level areas. They are composed of rather pure quartz and weather into distinctly acid soils, on which a number of characteristic oxylophytes are found.

The granites, syenites, and other igneous rocks of the Iron

Mountain sub-region also produce acid soils, but on account of the hardness of the rocks they are usually not so pronouncedly acid as are those of the sandstone areas. Other local areas of sandstone, with resulting acid soils, are found on the eastern side of the region, where the La Motte sandstone outcrops along the east side of the Iron Mountains and the Ste. Genevieve sandstone near the Mississippi River, and also towards the western side where there are numerous small areas of Pennsylvanian sandstone.

East of the Iron Mountains and along the Mississippi River local outcrops of Silurian, Devonian, and Lower Carboniferous age occur; and limestones of the Mississippian series also underlie considerable areas along the west side of the Ozark dome and extend beyond into the Prairie region. The limestones of this series are nearly pure calcium carbonate, and they usually produce fertile alkaline soils. But chert is also present in these beds, sometimes in large quantities, and acid or sub-acid soils are found locally on eroded ridges or slopes.

Shales are not abundant in most parts of the Ozark region, but they sometimes occur as separating layers between the strata of dolomite or limestone, and some thicker beds of Devonian or earliest Mississippian age outcrop locally on both sides of the plateau. The shales disintegrate into stiff soils or clays, which are generally acid, and on account of poor drainage, dripping banks or barrens, according to the location and slope, may be found in such places.

The flora of the Ozark region is more complex and varied than that of either of the other plant regions of the state, and several rather distinct sub-regions and plant colonies can be recognized in it. Considered as a botanical region, the boundaries both on the north and the west side extend somewhat beyond the Ozark plateau. The richness and diversity of the flora can be attributed to the present topography, drainage, and surface geology, and to the geologic history of the region.

The geographical position of the Ozark region on the American continent and its long geologic history both point to the probability of its having been a center of plant development

and distribution from early times, and it is extremely likely that some of the Ozarkian-Alleghenian species originated here and were dispersed from this center instead of the migration having been in the opposite direction, and the same may be true of some of the plants that now range widely to the southwest. Most of the trees that now form the Ozark forests seem to have invaded the region from the south in comparatively recent times, although their ancestors may have occupied it before they were driven out by the cold climate of the Pleiostocene. A few woody species and many herbaceous ones now confined to the Ozark region or found also throughout a wider range only in special habitats often far apart may have first appeared here. As examples of such woody plants may be mentioned *Castanea ozarkensis, Hamamelis vernalis, Cladrastis lutea, Andrachne phyllanthoides,* and *Cotinus americanus.* It is interesting to note that nearly all of these belong to ancient genera common to both eastern Asia and North America.

The scattered distribution of many Ozark plants and the presence in the region of numerous relic species and colonies of plants, some of which are described later, can readily be understood when it is remembered that it has been a continuous land surface but with changing boundaries, elevations, climate, and other ecological conditions since late Paleozoic time, and it is not surprising that of the numerous waves of plant life that have passed over it during this time, some of the later ones at least should have left recognizable traces in the present flora.

Viewed broadly, the flora of the Ozark region is a forest flora, with the oak-hickory type of woods prevailing on the uplands, and with mixed or pure stands of yellow pine on some of the higher ridges. The hard-wood trees are usually of small or medium size and in places they are distinctly stunted. The forest in the alluvial valleys is much richer in species and the trees attain a considerably larger size. Only traces of the forest now remain in the valleys, as most of the land has been cleared for agricultural use. The forest, with its associated herbaceous plants, belongs to the great Carolinian flora, and

floristically it is intermediate between the austral and boreal phases, with a slight preponderance of southern species. The herbaceous plants of general distribution on the uplands are usually species that range from the Appalachian plateau to the grassy plains.

In the protection of bluffs along the larger streams and in the deep V-shaped valleys of the more rugged parts of the region, many plants of more northern range are found, and in various places, especially towards the western side of the plateau, there are numerous prairie openings and rocky glades and barrens in which plants of western or southwestern distribution are an important or dominant element. In a number of other local areas scattered throughout the region, generally where some unusual ecological condition prevails, small colonies or single species of plants are found that do not seem to belong to the general flora. The presence of some of these relic species is interesting and significant and may help to throw light on the geological and botanical history of the region.

Sink-hole ponds.—In portions of the Ozark region occur what are locally known as "sink-hole ponds." These are small, shallow, usually circular bodies of water which occupy natural depressions in the level upland plateau, and are best developed in certain of the flatter portions of the Ozark Plateau, particularly in Dent, Shannon, Texas, and Howell counties. The sink-holes become gradually built up with soil and humus until only a shallow depression remains which fills up with water that usually stands throughout the year. Floristically, these natural ponds are extremely interesting. They are generally surrounded by an upland oak-hickory forest of *Quercus palustris, Q. coccinea, Q. marilandica, Q. stellata* associated with *Carya cordiformis, C. alba, C. Buckleyi* var. *arkansana, C. ovalis* var. *obcordata,* and sometimes other trees. Bushes of *Cephalanthus occidentalis,* and *Hibiscus lasiocarpus* often occur, standing in one to three feet of water. The lower crotches of these shrubs may support large tussocks of *Carex decomposita,* among which or separately may be growing plants of *Viola lanceolata, Lycopus rubellus, Steironema lanceolatum,*

and *Galium Claytoni.* Aquatic species in great variety attain a luxuriant development in these ponds, among which are *Potamogeton pulcher* and *P. diversifolius, Glyceria acutiflora, Eleocharis acicularis, Spirodela polyrhyza, Heteranthera reniformis* and *H. limosa, Brasenia Schreberi, Ranunculus aquatilis* var. *capillaceus, R. pusillus, R. oblongifolius, Callitriche heterophylla, Scirpus americanus, Polygonum hydropiperoides, Myriophyllum heterophyllum, Sagittaria heterophylla* and *S. graminea,* and *Utricularia gibba.* Along the pond margins may occur *Gratiola lutea* and *G. virginiana, Acorus Calamus,* and other species. Certain ponds support distinct species. *Glyceria acutiflora* and *Carex decomposita* have been found only in such ponds, while *Viola lanceolata* is known from only two isolated stations in southeastern Missouri, one of which is in a sink-hole pond.

CHARACTERISTIC PLANTS OF GENERAL DISTRIBUTION IN THE OZARK REGION

Adiantum Capillus-Veneris
Polypodium polypodioides
Pteridium latiusculum
Asplenium Trichomanes
Camptosorus rhizophyllus
Pinus echinata
Aristida purpurascens
Panicum sphaerocarpon
Paspalum circulare
Commelina virginica
Quercus Shumardii var. *Schneckii*
Quercus velutina var. *missouriensis*
Celtis laevigata var. *texana*
Celtis pumila var. *georgiana*
Silene virginica
Arenaria patula
Ranunculus Harveyi
Aristolochia tomentosa
Hepatica americana
Hamamelis vernalis
Cocculus carolinus
Calycocarpum Lyoni
Hydrangea arborescens
Aruncus sylvester
Gillenia stipulata
Crataegus collina
Rosa subserrulata
Lespedeza Stuevei
Lespedeza intermedia
Lespedeza hirta
Cassia nictitans
Baptisia vespertina
Vicia caroliniana
Clitoria mariana
Polygala verticillata var. *ambigua*
Crotonopsis elliptica
Euphorbia commutata
Vaccinium arboreum var. *glaucescens*
Vaccinium stamineum
Vaccinium stamineum var. *neglectum*
Vaccinium vacillans var. *crinitum*
Ilex decidua
Rhamnus caroliniana
Vitis rupestris
Ascyrum hypericoides
Passiflora lutea
Angelica villosa
Eulophus americanus
Ligusticum canadense
Nyssa sylvatica

Bumelia lanuginosa
Steironema quadriflorum
Amsonia illustris
Vincetoxicum carolinense
Heliotropium tenellum
Onosmodium subsetosum
Scutellaria incana
Cunila origanoides
Monarda Bradburiana
Aureolaria pectinata
Aureolaria grandiflora var. *cinerea*
Agalinis Skinneriana
Buchnera americana
Ruellia pedunculata
Galium virgatum
Galium arkansanum
Spermacoce glabra
Houstonia longifolia
Lonicera flava
Viburnum rufidulum
Triosteum angustifolium
Silphium Asteriscus
Parthenium hispidum
Eupatorium coelestinum
Brickellia grandiflora
Solidago Gattingeri
Solidago hispida
Solidago petiolaris var. *Wardii*
Solidago arguta var. *Boottii*
Aster patens
Aster linariifolius
Aster ptarmicoides
Grindelia lanceolata
Rudbeckia speciosa
Rudbeckia missouriensis
Helianthus occidentalis
Coreopsis lanceolata
Coreopsis pubescens
Hieracium longipilum

Most of the plants on the above list are well distributed throughout the region and a few of them are found occasionally beyond the limits of the Ozarks either in the Southeastern lowlands or in the Prairie region; others are comparatively rare and local but are not confined to any one of the well-defined subdivisions. Many of the commonest trees, shrubs, and herbaceous plants of the Ozark region are found throughout the state and for that reason are not on this list. These include amongst woody plants the red cedar, several species of willows, cottonwood, ironwood, hop hornbeam, most of the oaks and hickories, red and American elm, hackberry, wild cherry, plums, red haws, roses, sassafras, sumachs, maples, lindens, mulberry, persimmon, ash, and many others.

The Granitic-siliceous sub-region.—Although the Iron and St. Francois Mountains, with smaller outlying areas of igneous rocks, constitute one of the most distinct sub-divisions of the Ozark region, the boundaries of this floral sub-region must be drawn more widely to include the surrounding sandstone areas, with a belt extending northward to beyond the Missouri River. This may be called the Granitic-siliceous sub-region. While there are many other places in the Ozark region where chert or

sandstone on the surface has given an acid character to the soil, this is by far the largest area and the one in which the influence on the flora of this type of soil can best be seen. The sandstones, being more friable and therefore disintegrating more rapidly, as well as being more permeable to water, furnish more favorable habitats for many oxylophytes than the granitic or porphyritic areas, and most of the local and characteristic species are found on or near sandstone outcrops. A rather stunted forest growth covers most of the region, but there are numerous open places in glades or where the bare rock comes to the surface on slopes or where it stands out as domes and peaks in the igneous areas or as bluffs and ledges of sandstone. Pine is found on some of the granite or trachyte hills and on the outcrops of sandstone as far north as Franklin County. The red cedar *(Juniperus virginiana)* is sometimes found growing on igneous or siliceous rocks, but it is much more frequent in limestone areas. Some of the trees of the Southeastern lowlands, such as Spanish oak, willow oak, black gum, and sweet gum, as well as a few herbaceous species, are found in the extreme southern part, but the dominant and characteristic element over the whole area is Alleghenian-Ozarkian, and a number of eastern plants reach their western limit of distribution here. Ericaceous plants are more abundant than in any part of the state, and the rosy azalea *(Rhododendron nudiflorum* var. *roseum)* is a characteristic species in this subregion.

PLANTS CHARACTERISTIC OF THE GRANITIC-SILICEOUS SUB-DIVISION OF THE OZARK REGION

Polypodium virginianum
Asplenium pinnatifidum
Athyrium acrostichoides
Thelypteris palustris var. *pubescens*
Thelypteris spinulosa
Thelypteris spinulosa var. *intermedia*
Dennstaedtia punctilobula
Lycopodium lucidulum
Lycopodium lucidulum var. *porophilum*
Lycopodium complanatum var. *flabelliforme*
Cyperus refractus
Carex glaucodea
Carex hystricina
Allium cernuum
Malaxis unifolia
Habenaria peramoena
Salix sericea
Stellaria longifolia
Cerastium arvense var. *oblongifolium*
Mitella diphylla
Saxifraga virginiensis

Saxifraga pensylvanica var. *Forbesii*
Hamamelis virginiana
Crataegus uniflora
Euphorbia obtusata
Linum striatum
Ilex verticillata var. *padifolia*
Frasera caroliniensis
Rhododendron nudiflorum var. *roseum*
Rhexia virginica
Vincetoxicum obliquum
Phlox glaberrima
Phlox maculata
Trichostema dichotomum
Salvia lyrata
Collinsonia canadensis
Pedicularis lanceolata
Aureolaria calycosa
Houstonia patens
Houstonia coerulea
Solidago suaveolens
Cirsium virginianum

The White River sub-region and the bald knobs.—In describing the drainage and the geology of the state mention has already been made of White River, which makes an incursion into the counties of Barry, Stone, and Taney, along the southern border. Another loop of this river also nearly touches the state boundary a little farther east, near the southwest corner of Ozark County, and all of the south-flowing streams as far east as Howell County are tributary to it.

The extremely rugged country bordering this river and the lower courses of some of its tributaries comprises one of the most interesting and distinct subdivisions of the Ozark region. The river in its circuitous course has cut a deep narrow valley through the nearly horizontal strata of the Ordovician rocks. Thick solid beds of dolomite, separated by softer layers of shale, underlie most of the area. Hard nodules or masses of chert are sometimes present in the dolomite or are strewn in broken fragments over the surface of the hills, and ledges or local outcrops of quartzite and sandstone appear in some of the bluffs and hills. The river bluffs sometimes have a height of 200 or 300 feet, and the stream in places impinges against them or is separated only by a steep rocky talus. On the opposite side there may be a narrow alluvial or gravelly valley, usually subject to occasional overflows. The uplands a little back from the river are covered with the typical oak-hickory forest of the Ozarks, but along the river bluffs and in the deep cañons of the tributary streams, as well as on the bald knobs, many rare and characteristic plants are found. Along the talus or alluvial strip at the base of the bluff there is usually a dense

growth of trees. The wider parts of the valley that were originally wooded with large trees have nearly all been cleared for cultivation, but floods often work destruction on crops and strip off the surface soil. Where there are irregular ledges or clefts along the face of the cliffs many small trees and shrubs as well as herbaceous plants have found lodgment. The character of the vegetation depends upon the exposure. Where this is to the north or northeast a number of eastern Appalachian species are present. Amongst these are the butternut, northern red oak, cucumber-tree *(Magnolia acuminata)*, yellowwood *(Cladrastis lutea)*, sugar maple, nettle-tree *(Celtis occidentalis* var. *canina)*, linden, staff-tree, and hydrangea, besides a luxuriant growth of ferns and other herbaceous plants. This association of plants is not, however, confined to this subregion, but most of the species are also found in similar situations throughout the Ozarks, as will be shown later.

On south and west exposures the assemblage of plants is quite different, especially on the higher levels of the bluff. Fantastically twisted and gnarled junipers often crown the crest of the cliffs or cling precariously to crevices and ledges along its face. The red cedar *(Juniperus virginiana)* is the common species, but in Barry County as well as farther south in Arkansas, another species, called the white cedar by the local inhabitants on account of its thick white sap-wood, has been found. In open situations this tree has a different habit from that of the red cedar, with usually several boles or branches arising from the base instead of a single trunk. It is also distinguished by the usually single seed of the fruit and by the minutely serrulate margins of the leaves. This was named *Juniperus Ashei* Buchholz[6] for the late Mr. W. W. Ashe of the U. S. Forest service, who first called attention to it, but a careful study of this species and a comparison with *Juniperus mexicana* Sprengel seem to indicate clearly that the two are identical and that the latter and older name should be applied to the white cedar of the Ozarks. The range of *Juniperus mexicana*, as given in the second edition of Sargent's 'Manual,'

[6] Bot. Gaz. **90**: 329. 1930.

is from Brazos County over the low limestone hills of western and southern Texas and southward into Mexico. It is very abundant on the limestone hills of the Edwards Plateau of central Texas and has recently been collected in the Arbuckle Mountains of Oklahoma, and as a number of other southwestern plants of similar range are associated with it in the White River sub-region there seems to be conclusive evidence that this flora at one time extended eastward to the Ozarks. In similar situations is also found the smoke-tree *(Cotinus americanus)*, one of the rarest of American trees, and known only from a few other isolated localities in Alabama, Kentucky, Arkansas, Oklahoma, and Texas. It is most abundant and attains its largest size here along the White River bluffs, where it sometimes reaches a height of 35 or 40 feet and a trunk diameter of over a foot. The soap-berry *(Sapindus Drummondii)* and *Acacia angustissima* var. *hirta*, both species of the Southwest, are sometimes found in protected situations along the talus at the base of the bluff, and a succulent vine, *Cissus incisa*, has been found in Taney and McDonald counties, where it grows in hot dry exposures on the face of the bluff. The Missouri currant *(Ribes odoratum)* grows on ledges or in clefts along the bluffs, usually in partial shade. Characteristic also of such places, although of wider distribution in the state, are *Celtis pumila* var. *georgiana*, *Celtis laevigata* var. *texana*, *Bumelia lanuginosa*, *Fraxinus quadrangulata*, *Rhus canadensis* var. *serotina*, and *Parthenocissus quinquefolia*; and amongst herbaceous plants, selecting situations with various degrees of exposure, are *Woodsia obtusa*, *Pellaea glabella*, *Asplenium resiliens*, *Notholaena dealbata*, *Cheilanthes Feei*, and rarely *C. alabamensis*, *Elymus virginicus* var. *glabriflorus*, *Uniola latifolia*, *Commelina erecta* var. *crispa*, *Mentzelia oligosperma*, *Scutellaria ovata*, *Aster oblongifolius*, and *Solidago radula*. It is evident that this is mainly a southwestern flora, and it contrasts strikingly with that of the north exposures in which Alleghenian species predominate.

But even more interesting and distinct than the flora of the river bluffs is that of the bald knobs, as the eroded hills oc-

cupying the divides between the valleys are locally known. The peculiar topography found here is due to the long-continued action of erosional forces upon the alternating harder and softer horizontal strata, consisting of compact layers of fine, porous dolomite sometimes two or three feet in thickness, separated by bands of shale or clay. The thicker ledges stand out as low bluffs encircling the terraced hills, separated by wide slopes of rather sterile soil which becomes thoroughly saturated with seepage water during rainy times and extremely dry later in the season. As a result of this unequal distribution of available moisture and other factors only a few small trees and shrubs have, at least until recently, been able to establish themselves on the hills, which stand out in striking contrast to the heavily wooded valleys. In parts of the region some of the higher hills are capped with remnants of the purer Mississippian limestone, and in such places there is usually a much more abundant woody growth as well as many herbaceous species not found on the dolomite.

A few small trees and a variety of shrubs are usually found along the outstanding ledges. Amongst the commonest species are *Quercus Shumardii* var. *Schneckii, Q. Muhlenbergii, Ulmus alata, Celtis laevigata* var. *texana, Cercis canadensis, Rhamnus caroliniana, Ilex decidua, Diospyros virginiana, Bumelia lanuginosa, Fraxinus americana,* and the woody twiner *Berchemia scandens.* On some of the steeper slopes *Cotinus americanus* is also found, as well as various other trees and shrubs from the surrounding forests. A number of herbaceous plants are also confined to the narrow protected strip at the foot of the ledges, but most of these are not restricted to the bald knobs but belong to the flora of the surrounding woods. The flora on the open slopes is not rich in the number of species, as most of the plants of the region cannot endure the conditions, and as a result those that are able to do so have a practical monopoly of the area. Some of these are so abundant locally and are so conspicuous when in flower that at such times the hillsides present a most brilliant and striking spectacle. Almost the only trees which flourish on these open slopes are the junipers

(*Juniperus virginiana* and more locally *J. mexicana,* and sometimes the former is abundant). Such low shrubs as *Rosa carolina, Ceanothus ovatus* var. *pubescens, Acacia angustissima* var. *hirta, Andrachne phyllanthoides,* and a few others may be found here. The *Andrachne,* locally called buck-brush, is the most abundant and characteristic, and it is interesting both because of its range, which extends through northern and central Arkansas and eastern Oklahoma to central Texas, and because it is the only woody member of the large and generally southern family of the Euphorbiaceae to extend so far north.

The herbaceous plants of these slopes are mostly either short-lived annuals or deep-rooted perennials. Amongst the most abundant and conspicuous are the tall larkspur (*Delphinium Treleasei),* an endemic species, the large-flowered evening primrose (*Oenothera missourensis,* locally known as glade lily), the pink- and the yellow-rayed cone-flowers (*Echinacea pallida* and *E. paradoxa),* blue wild indigo (*Baptisia vespertina),* black-eyed-Susan (*Rudbeckia missouriensis),* and *Hymenopappus scabiosaeus.* In certain places the purple-bracted horse-mint (*Monarda citriodora)* and the large-flowered purple beard-tongue (*Pentstemon Cobaea* var. *purpureus)* are abundant, and both are very showy when in bloom. A number of other less conspicuous plants are also characteristic of the bald knobs, and many of them are found nowhere else in the state while others occur elsewhere locally in glades. These are included in the fuller list given in a later paragraph. An examination of this list will show that here also, as on the bluffs with south and west exposures, the predominant element in the flora is of southwestern range, but that mingled with such plants are also a number of species that have come from the eastern Appalachian region. In both cases they seem to be relic colonies isolated on these bald knobs and to include many species that have survived through adaptation to the peculiar conditions found here, while they are unable to compete with the more widespread and aggressive plants making up the present flora of the general region. The significance of such colonies in indicating the climatic changes that have occurred

in the region and in contributing evidence on its geologic history is very great, and it is interesting to see whether we can determine through their aid something of the sequence of events that brought these successive invasions of plants from different directions into the region.

In describing the Southeastern lowlands it was stated that the flora now confined to that section in Missouri probably occupied much of the area of the Ozark region before its last elevation, and it was suggested that the distribution of several species now scattered throughout parts of the state beyond this region may be accounted for in this way. Some of the plants found in the White River country and on the bald knobs seem to furnish even more conclusive evidence of this.

The small form of the cane *(Arundinaria gigantea)*, a typical species of the Coastal Plain from Maryland and Florida to eastern Texas and extending with other southern plants into the Mississippi Embayment area of southeastern Missouri, where it grows in low wet woods and alluvial banks of streams and bayous, is also found along White River and its tributaries in southwestern Missouri. In this part of its range it usually grows at the foot of rocky bluffs, often in widely separated stations and under very different conditions from those found in the lowlands. The southern red oak *(Quercus falcata)* is a tree of wide distribution in the Coastal Plain, and it is a characteristic species of the Southeastern lowlands, growing on the low elevations or in the better-drained bottom lands. It is also found along White River as far west as Barry County, Missouri, and Carroll County, Arkansas, where it has taken to the dry rocky hills. The fringe-tree *(Chionanthus virginica)* has a similar range, although more restricted in Missouri, where it is known locally in the lowlands of Mississippi County and in dry rocky uplands along the North Fork of White River, in Ozark County. Similarly, the herbaceous *Hymenopappus scabiosaeus*, a common plant of sandy areas in the Coastal Plain and found in the lowlands in Scott and Mississippi counties, reappears as a characteristic species of the glades and bald knobs along White River. Other southern plants with

a somewhat similar distribution in Missouri are the cucumber tree *(Magnolia acuminata)* and the leguminous *Rhynchosia latifolia.* The widely scattered distribution of *Forestiera acuminata, Rhamnus caroliniana,* and *Ilex decidua* has already been mentioned. All of them are found along White River, the first growing along the river margins or along sloughs and old channels, and the others along rocky ledges of the bald knobs.

Most remarkable of all, however, is the supple-jack or rattan vine *(Berchemia scandens),* both for its abundance and the way in which it has adapted itself to conditions entirely different from those of its usual habitats. In the Coastal Plain, where it is found from Virginia and Florida to eastern Texas and in the Southeastern lowlands of Missouri, it usually grows in swamps or low wet woods, and there it is a slender twiner, winding its tough stems about the trunks of shrubs and trees, which it sometimes ultimately strangles in its strong embrace. On the bald knobs, to which it is confined in the White River sub-region, it generally has a somewhat shrubby habit in the absence of any support, although the slender branches find support on the rocky ledges or on shrubs or small trees where they are at hand. It has also adapted itself to the irregular water supply afforded by the run-off from the hills after rains and the seepage from the rocky ledges that continues for some time afterwards. After this is exhausted the ground often becomes very dry and sterile for a considerable period. In this case, since the plant is not found at all in the alluvial valley or along the bluffs, it is scarcely reasonable to believe that it could have surmounted the present wide barrier of the rocky uplands between the old Mississippi Embayment area and the bald knobs or that it may have been introduced on these hills by some unaccountable circumstance, have survived in so unusual an environment, and have spread from one isolated glade to another. The only reasonable explanation of its presence here seems to be that it is a relic of former general distribution through the region prior to its last elevation, and that it is one of the species that, finding itself stranded in the grad-

ually rising Ozark region, succeeded in accommodating itself to the conditions that have slowly developed in the glades of the bald knobs, where competition with other species has not been too keen.

But before considering further the significance of these remarkable relic colonies it may be well to mention others of a somewhat similar character found in other parts of the Ozark region.

CHARACTERISTIC PLANTS OF THE BALD KNOBS, SOME OF WHICH ARE ALSO FOUND IN ROCKY LIMESTONE OR DOLOMITE GLADES IN OTHER PARTS OF THE REGION

Ophioglossum Engelmanni
Isoetes Butleri
Juniperus virginiana
Juniperus mexicana
Sporobolus neglectus
Carex Crawei
Carex Meadii
Allium stellatum
Nemastylis acuta
Agave virginica
Arenaria patula
Talinum calycinum
Leavenworthia uniflora
Delphinium Treleasei
Acacia angustissima var. *hirta*
Andrachne phyllanthoides
Berchemia scandens
Hypericum pseudomaculatum
Oenothera missourensis
Stenosiphon linifolius
Evolvulus argenteus
Scutellaria Bushii
Satureja glabra
Monarda citriodora
Amsonia ciliata var. *tenuifolia*
Pentstemon Cobaea var. *purpureus*
Heliotropium tenellum
Centaurium texense
Hymenopappus scabiosaeus
Echinacea paradoxa
Solidago Gattingeri
Aster sericeus
Aster oblongifolius
Aster oblongifolius var. *rigidulus*
Liatris cylindracea
Marshallia obovata var. *platyphylla*
Palafoxia callosum
Rudbeckia missouriensis
Coreopsis lanceolata var. *villosa*

Glades and barrens of the Ozark region.—Rocky glades and open hillsides upon which ledges of rock come to the surface are found scattered throughout the Ozark region, and many characteristic plants, some of which are remote from the main area of their range, are found in such places. A considerable number of the species found on the bald knobs also grow in some of the rocky glades. Some of the characteristic plants are common to most of the glades, while others are restricted to a few localities or to a single station.

The term glade is used here for small open areas in the forest where rocks outcropping on the surface prevent the encroachment of most trees and shrubs. The name barren has also sometimes been given to such areas, but it should perhaps be restricted to larger areas or to those with a different type of soil and ecology, and in the Ozark region it is used colloquially for the larger prairie openings which properly are extensions of the Prairie region.

Glades are most abundant in limestone and dolomite areas, but they are also frequently found on sandstone outcrops or on those of igneous rocks in the Iron Mountain sub-region, and in southwestern Missouri on exposures of chert. The type of vegetation differs somewhat with the nature of the rocky outcrop. *Selaginella rupestris, Cheilanthes lanosa, Crotonopsis elliptica, Hypericum gentianoides,* and *Trichostema dichotomum* are characteristic plants of the igneous or siliceous rocky barrens, and other species of *Hypericum* and shrubby species of *Vaccinium* are usually also present.

The chert glades of southwestern Missouri are so distinct in their flora from any other part of the Prairie region that they should be treated separately. They are found in the valleys of Turkey Creek and Shoal Creek, in Jasper and Newton counties, and lie beyond the borders of the Ozark plateau. Solid beds of the Grand Falls Chert of the Mississippian series come to the surface in several places along the borders of streams, and in the depressions of the irregular hummocks there is an accumulation of soil which is generally acid but enriched with alluvium. As the rock is impermeable except where fractured, water also fills the depressions after rains and often remains there until evaporated by the sun. This combination has produced unusual ecological conditions, and a number of plants are found here that are known nowhere else in the state, and others that are known only here and in the trachyte or granite glades of the Iron Mountain sub-region. Most of the characteristic species are of southern or southwestern distribution.

CHARACTERISTIC PLANTS OF THE CHERT GLADES

Cheilanthes lanosa
Selaginella rupestris
Isoetes melanopoda
Cyperus inflexus
Scirpus carinatus
Allium mutabile
Rumex hastatulus
Polygonum tenue
Arenaria patula
Talinum parviflorum
Talinum calycinum
Portulaca parvula
Portulaca retusa
Selenia aurea
Sedum Nuttallianum
Saxifraga texana
Lathyrus pusillus
Crotonopsis elliptica
Hypericum pseudomaculatum
Opuntia macrorhiza
Opuntia Rafinesquii
Chaerophyllum texanum
Spermolepis echinata
Cynosciadium pinnatum
Phacelia hirsuta
Ruellia caroliniensis var. *parviflora*
Specularia leptocarpa
Coreopsis lanceolata
Coreopsis tinctoria
Krigia occidentalis

Limestone and dolomite glades.—The list of plants found in the limestone and dolomite glades is a long one, but many of the species are common also to the rocky woods or prairies. Some are found generally in the larger prairie openings or barrens of the Ozark region or on the uplands of the adjoining Prairie region, and a few of them also grow in glades of sandstone or igneous areas. The glades often merge gradually into the rocky woods, and shrubs or small trees may encroach and establish themselves in parts of the glade or about its margins. An invasion of herbaceous woodland species soon follows in such places. Many of the species of the following list are nearly always present in glades of this class, while other are comparatively rare and restricted.

CHARACTERISTIC PLANTS OF LIMESTONE AND DOLOMITE GLADES

Ophioglossum Engelmanni
Isoetes Butleri
Juniperus virginiana
Sporobolus asper var. *pilosus*
Sporobolus ozarkanus
Bouteloua curtipendula
Carex Crawei
Carex Meadii
Allium mutabile
Allium stellatum
Nothoscordum bivalve
Camassia hyacinthina
Agave virginica
Nemastylis acuta
Oxybaphus albidus
Arenaria patula
Portulaca parvula
Talinum calycinum
Clematis Fremontii
Sedum pulchellum
Delphinium Penardi
Delphinium azureum var. *Nortonianum*
Draba cuneifolia
Erysimum asperum

Lesquerella gracilis
Lesquerella angustifolia
Leavenworthia uniflora
Baptisia vespertina
Psoralea esculenta
Psoralea tenuiflora
Petalostemum purpureum
Petalostemum albidum
Astragalus distortus
Astragalus mexicanus
Euphorbia zygophylloides
Tragia urticaefolia
Rhus canadensis var. *serotina*
Rhamnus caroliniana
Opuntia Rafinesquii
Mentzelia oligosperma
Malvastrum angustum
Oenothera missourensis
Oenothera speciosa
Chaerophyllum texanum
Polytaenia Nuttallii
Cogswellia daucifolia
Phacelia hirsuta
Heliotropium tenellum
Onosmodium hispidissimum
Onosmodium subsetosum
Dodecatheon Meadia
Asclepiodora viridis
Acerates viridiflora
Isanthus brachiatus
Monarda citriodora
Galium virgatum
Houstonia angustifolia
Echinacea pallida
Solidago Gattingeri
Aster sericeus
Aster oblongifolius
Aster ptarmicoides
Thelesperma trifidum
Silphium terebinthinaceum

In the deep narrow valleys and along the bases of the high bluffs with a northern or eastern exposure, and especially in the rich woods formed by the talus, soil accumulations, and humus, many plants of northern and Appalachian range are found. A few of these were mentioned as growing in such situations along White River, and many of them extend throughout the Ozark region and sometimes beyond along the higher stream bluffs in the Prairie region, or they may grow in more open situations farther north.

CHARACTERISTIC PLANTS OF NORTH-FACING BLUFFS OF THE OZARK REGION

Adiantum pedatum
Athyrium asplenioides
Athyrium angustum var. *rubellum*
Athyrium angustifolium
Cystopteris bulbifera
Cystopteris fragilis
Brachyelytrum erectum
Carex Jamesii
Carex laxiflora
Carex eburnea
Arisaema triphyllum
Uvularia grandiflora
Smilacina racemosa
Polygonatum canaliculatum
Erythronium americanum
Erythronium albidum
Trillium sessile
Trillium recurvatum
Cypripedium parviflorum and var. *pubescens*
Juglans cinerea
Asarum canadense
Asarum canadense var. *reflexum*
Thalictrum dioicum

Hepatica americana
Aquilegia canadensis
Isopyrum biternatum
Actaea brachypoda
Caulophyllum thalictroides
Sanguinaria canadensis
Dicentra Cucullaria
Dicentra canadensis
Corydalis flavula
Hydrangea arborescens
Ribes Cynosbati
Polygala Senega var. *latifolia*
Evonymus obovatus
Tilia glabra
Tilia heterophylla var. *Michauxii*
Staphylea trifolia
Acer saccharum
Acer saccharum var. *glaucum*
Dirca palustris
Aralia racemosa
Erigenia bulbosa
Osmorhiza Claytoni
Osmorhiza longistylis
Cryptotaenia canadensis
Taenidia integerrima
Thaspium barbinode
Thaspium trifoliatum var. *flavum*
Hybanthus concolor
Hydrophyllum appendiculatum
Viburnum molle
Solidago caesia
Solidago latifolia
Eupatorium urticaefolium
Senecio obovatus var. *rotundus*

Before summarizing this sketch of the Ozark flora, mention must be made of another interesting plant colony where a number of rare species are found, some of which are not known elsewhere in the state. Mr. B. F. Bush, while collecting in Shannon County many years ago, came upon a locality along Jacks Fork of Current River where high bluffs of magnesian limestone, in places capped by beds of Roubidoux sandstone border the stream. A most unusual assemblage of plants was found here, many of them growing on the dolomite, either at the base of the bluff or along ledges, and others growing on the sandstone either along the top of the bluff or along outcrops a little way back from the stream. Mr. Bush visited this locality a number of times, exploring it thoroughly and collecting and distributing many plants from it. Amongst species of special interest that have been found near Jam-up Bluff, as the high point along the river is known, are *Scirpus planifolius, Carex Careyana, C. leptalea, C. laxiculmis* var. *copulata, Zigadenus elegans, Cypripedium Reginae, Spiranthes lucida, Berberis canadensis, Potentilla canadensis* var. *villosissima, Parnassia grandifolia, Hypericum gymnanthum, Galium boreale* var. *hyssopifolium, Campanula rotundifolia, Senecio obovatus* var. *umbratilis, Trautvetteria carolinensis, Artemisia campestris* var. *caudata, Solidago rugosa* var. *aspera,* and

S. juncea. Growing in the same locality or near by are the following plants, most of which, although known in other localities in the state, are found here and seem to be part of the association: *Asplenium cryptolepis, Veratrum Woodii, Cypripedium candidum, Ribes Cynosbati, Evonymus obovatus, Dirca palustris, Cornus alternifolia,* and *Solidago caesia.*

While collecting during 1934 and 1935 in Texas County, the junior author came upon a locality in a deep limestone cañon where a number of these rare species were growing under similar conditions, and the two localities are evidently closely associated phytogeographically. The range of most of these species (excluding those that are southern Appalachian) is in the glaciated areas in northern Missouri or farther north beyond the borders of the state, and their presence in the heart of the Ozark region far beyond the recognized limits of glaciation would clearly indicate a relic colony that has survived from the time when this northern flora extended much farther south than it does at present in Missouri. They have held out in peculiarly protected or favored spots after changing ecological conditions had brought about the general destruction or migration of the floras of which they were a part and had replaced them generally with others more adapted to the new conditions.

It has been pointed out that a number of species from the Coastal Plain flora, which in its full development is now found in Missouri only in the Southeastern lowlands, are isolated in the bald knobs of the White River sub-region and in other parts of the Ozarks; and these plants probably constitute one of the oldest recognizable elements in the present plant life of the region, harking back to conditions that prevailed before its last elevation in late Tertiary time. This does not of course necessarily mean that they have occupied continuously the exact locations where they are now found, but merely that they were never entirely exterminated in the region.

Many of the plants of general northeastern and Appalachian distribution now found in the deep cañons and along north-facing bluffs may also have persisted in the region since pre-

glacial times. For the possibility should not be overlooked that some of these species, as well as those of earlier and later periods, may have been developed in the Ozark region and have been dispersed from this center. And it is scarcely likely that extensive immigration could have taken place from the east after the development of the wide flood plains of the Mississippi River, which offers an effective barrier to many upland species.

Finally, the mainly xerophytic plants of southwestern range, which are now found in the glades, on the bald knobs, and along the south-facing bluffs of White River and other streams, and which are the best preserved and most obvious relic colonies in the region, are probably of still more recent origin, and are remnants of a prairie or plains flora that penetrated into central North America during a period of increasing aridity some time subsequent to the final retreat of the glaciers, perhaps within the last few millenia. Relics of this flora are still recognizable as far east as the cedar glades of middle Tennessee and in several adjoining states. It would seem, however, that the climate at this time, while greatly influencing and changing the character of the flora on the uplands, was not sufficiently arid to destroy or drive out all of the northern flora nor even all traces of the old Tertiary forest flora from the protecting valleys in the Ozark region. Conditions at the maximum of this cycle may perhaps have been comparable to those which prevail at present in the Edwards plateau of central Texas, where a number of the peculiar species of the Ozark glades and bald knobs are now found on the limestone hills, and relic colonies of eastern mesophytic species survive in the cañons.[7]

There is abundant evidence of various kinds that such a period of widespread aridity occurred about the time we have indicated, both in America and in the Old World. That it profoundly affected the flora and through it, as well as in other ways, the development and culture of man, groping his way

[7] See Palmer, E. J. Canyon flora of the Edwards Plateau of Texas. Jour. Arnold Arb. 1: 233. 1920.

up through savagery or the first stages of civilization, is probable. And so botanical evidence may aid in clarifying or confirming the theories of the climatologists and geologists in working out the story of the past.

THE PRAIRIE REGION

The flora of the Ozark region and that of the Prairie region merge gradually into each other in many places, and the boundary between them is nowhere so clearly drawn as that between the Southeastern lowlands and the former. While the generally open treeless character of the uplands distinguishes and gives name to the region, it is really one of transition from the eastern forest that has now reestablished itself over most of the Ozark plateau, and the western prairies. The alluvial valleys of the larger streams were all occupied by narrow strips of forest until largely cleared off since the settlement of the country. The forests are of similiar type to those along the Ozark streams, although a number of the southern species begin to disappear towards the north and a few northern ones to come in. As in the Ozark region, the larger valleys may have remained wooded through the period of more arid climate.

The Prairie region may be separated into two main divisions: the Glaciated and the Unglaciated sub-divisions. The first occupies most of the area north of the Missouri River, except a narrow strip along that stream and along the Mississippi River near their junction, and it also includes small areas to the south of the Missouri, in St. Louis, Saline, Cooper, Lafayette, and Jackson counties. In the small unglaciated areas north of the Missouri River, the flora, as well as the topography along the river bluffs, has more in common with that of the Ozarks, and it has been considered as part of that region.

Stratified rocks of Silurian, Devonian, and Lower Carboniferous age underlie the glacial drift in several of the eastern counties. These earlier Paleozoic rocks are mostly limestones, sometimes carrying chert, and with more limited areas of shale and sandstone. Westward and throughout most of this subregion the underlying deposits are the sandstones and shales

of the Pennsylvanian series, with local beds of limestone in a few places. Glacial drift, till, or loess covers most of the uplands, but the older stratified rocks come to the surface in places where the drift has been removed, and especially along bluffs of streams. Much of the material brought in by the glaciers has been redistributed both as alluvium in the valleys and gravel bars along the streams and as loess in several parts of the sub-region. As the flora found on the loess hills in the northwestern part of the state is so distinct, it will be described in a separate paragraph.

There is considerable mechanical as well as chemical difference in the soils of the different parts of the glaciated uplands, and they vary greatly in fertility. However, in general they are more uniform over wide areas than are the residual soils of the Ozark region and of the unglaciated prairies. Judging by the character of the flora, neutral or subalkaline soils are most common.

A typical prairie flora, consisting largely of grasses and perennial herbs in which legumes and composites played a conspicuous part, covered the uplands before they were brought under agriculture. Only a few traces of this now remain, the best examples being along the fenced right-of-way of the railroads. Most of the species of this flora are also found in the unglaciated areas farther south. There are few or no trees along the margins of most of the smaller streams, but sometimes there are a few cottonwoods or willows or small thickets of shrubs alternating with the tall grass and ranker growth of herbs. Amongst common species here, besides the black willow and cottonwood, are *Salix cordata, S. missouriensis, S. interior, Prunus americana, P. virginiana, Amorpha fruticosa, Vitis vulpina, Cornus asperifolia, Cephalanthus occidentalis,* and *Viburnum prunifolium.* Of this list only the choke cherry *(Prunus virginiana)* is practically restricted to the sub-region.

In addition to this widely spread prairie flora of the uplands, which centers in the western plains, and the wooded strips of the alluvial valleys, evident extensions of the eastern and

southern forest, there is a sprinkling of distinctly northern plants that are generally distributed over the glaciated areas of the middle and eastern states. These plants, although forming a comparatively small percentage of the flora, are the most characteristic species in distinguishing this sub-region. Less detailed study of the flora has been done in this sub-region than in any other part of the state, and it is probable that the small list of characteristic species could be considerably increased if systematic collecting were undertaken in all of the counties.

The flora of the loess areas, or where the glacial drift has been redistributed, has little to distinguish it from that of the drift areas except on the terraced bluffs and mound-like hills along the Missouri River in the northwestern corner of the state. So many peculiar plants are found in that locality that it must be regarded as a small but distinct sub-region.

CHARACTERISTIC PLANTS OF THE GLACIATED SUB-DIVISION OF THE PRAIRIE REGION

Pteretis nodulosa
Phalaris arundinacea
Phragmites communis var. *Berlandieri*
Calamagrostis canadensis var. *Macouniana*
Allium tricoccum
Smilacina stellata
Medeola virginiana
Salix petiolaris
Salix cordata var. *angustata*
Populus tremuloides
Urtica procera
Anemone canadensis
Spiraea alba
Rosa blanda
Rosa suffulta
Prunus virginiana
Quercus ellipsoidalis
Ulmus Thomasi
Acer nigrum
Acer Negundo var. *violaceum*
Vitis vulpina
Asclepias Sullivantii
Lithospermum caroliniense
Phlox pilosa var. *fulgida*
Collomia linearis
Chelone obliqua var. *speciosa*
Fraxinus pennsylvanica
Sambucus racemosa
Viburnum Lentago
Viburnum affine var. *hypomalacum*
Lonicera dioica var. *glaucescens*
Senecio pauperculus
Prenanthes alba
Artemisia vulgaris var. *gnaphalodes*
Antennaria neglecta

Several of the species of this list are quite local within the area and others are not strictly confined to the glaciated areas, but they are typical plants of the northern flora that in a few cases have spread somewhat farther south.

The loess is best developed and attains its greatest thickness above the bluffs of the Missouri River, interruptedly, from the northwest corner of the state to below Kansas City. Because of the rapid and characteristic way in which erosion has worked upon it, a peculiar type of topography, with terraced hills or mounds separated by deep, steep-sided ravines, has been developed. The best examples of this topography are found in Atchison and Holt counties, and a number of plants from the northwestern plains are found here and are restricted to this sub-region.

The alluvial lands along the river are heavily wooded, and many of the forest species extend up the deeper ravines, but rapid erosion and wind action have kept the slopes bare in most places, although a few woody plants are found at the tops of some of the mounds. Occasionally a few cottonwoods and willows and a stunted form of the bur oak grow in such places or on the slopes where they are not too steep. Grasses and other herbaceous plants constitute the bulk of the flora, and some of the plains species reach their eastern limit here. The bear grass *(Yucca glauca)* is one of the most characteristic species. Amongst the few other shrubs are the prairie willow *(Salix humilis)*, the lead plant *(Amorpha canescens)*, and the downy-leaved red-root *(Ceanothus ovatus* var. *pubescens)*. The low oak, *Quercus macrocarpa* var. *olivaeformis*, is abundant in places. It is usually a stout spreading shrub, but may become a small tree in protected situations. The fruit is small and elongated and the leaves are extremely variable in shape.

The incursion of this northwestern flora into the state may have taken place about the same time that the plants of the southwestern plains overran the Ozark region. Due to the somewhat drier conditions that still prevail here and to the rapid rate of erosion, this flora has not had to encounter the competition of the advancing forest that has pressed upon and almost engulfed the xerophytic plains flora to the south, so that it has remained dominant over the small favorable areas of the loess hills.

CHARACTERISTIC PLANTS OF THE LOESS HILLS

Muhlenbergia cuspidata
Bouteloua hirsuta
Bouteloua gracilis
Sporobolus airoides
Yucca glauca
Anemone cylindrica
Chenopodium dakoticum
Atriplex patula
Quercus macrocarpa var. *olivaeformis*
Cleome serrulata
Rosa polyanthema
Rosa conjuncta
Oxytropis plattensis
Astragalus lotiflorus
Psoralea argophylla
Dalea enneandra
Glycyrrhiza lepidota
Euphorbia serpens
Euphorbia marginata
Euphorbia glyptosperma
Oenothera serrulata
Gaura coccinea
Teucrium occidentale
Pentstemon grandiflorus
Castilleja sessiliflora
Symphoricarpos occidentalis
Liatris acidota
Heterotheca subaxillaris
Artemisia vulgaris var. *gnaphalodes*
Cirsium discolor
Lygodesmia juncea
Lactuca pulchella
Chrysopsis Berlandieri

Salt licks and saline springs.—Natural saline areas occur in the form of salt "licks" and saline springs, and are found in portions of the prairie region, particularly the glaciated prairie, in areas adjacent to streams and usually in territory of low relief. They reach their greatest development in middle Missouri in Saline, Randolph, Howard, and Cooper counties. The soil immediately around such springs is heavily charged with concentrated alkaline salts, and supports an unusual assemblage of plants, some of which are known only from such places. *Typha angustifolia* and *Eleocharis parvula* have been found in marshy ground around certain saline springs, and are known in Missouri only from these stations. Floating in the water of the springs or branches from them are clumps of *Zannichellia palustris, Potamogeton pectinatus, Callitriche heterophylla,* and species of *Chara* and *Nitella.* Other species which are found around the saline springs include *Scirpus americanus, S. fluviatilis, Typha latifolia, Diplachne fascicularis* and *D. acuminata, Atriplex rosea* and *A. patula* var. *hastata, Polygonum aviculare* and var. *angustissimum, Echinochloa pungens,* and many others.

The Unglaciated sub-division of the Prairie region.—There is no even approximate natural boundary between the Ozark

region and the unglaciated part of the Prairie region to the west of it as is formed by the Missouri River on the north, and the line of demarcation is often very irregular and indefinite, with the Ozark flora dominant on broken rocky ground along streams and the prairie flora occupying the more level and open parts of the uplands over a wide transition zone. This is particularly noticeable in areas of Mississippian limestone and chert, which is the surface formation along most of the border line, with an increasing width towards the south. As the soils of the uplands are all residual, it is easy to account for this rather sharp contrast between the flora growing on different geological formations. West of this belt of limestone and over most of the sub-region the sandstones and shales of the Pennsylvanian series are the surface rocks. Because of the comparatively soft character of these formations some of the streams have developed broad shallow valleys, subject to frequent overflow, and with numerous small shallow lakes and sloughs in which many aquatic and semi-aquatic plants flourish. These wide flood plains are particularly well developed along the Grand and Marais des Cygnes rivers and some of their small tributaries. *Typha latifolia, Leersia virginica, L. oryzoides, Spartina pectinata, Nelumbo pentapetala, Nymphozanthus advena, Ceratophyllum demersum, Jussiaea diffusa, Myriophyllum scabratum, Proserpinaca palustris* var. *crebra,* and species of *Potamogeton* and *Sagittaria* are characteristic of such places. The pin oak *(Quercus palustris)* is abundant along the smaller streams and in the borders of low woods, and the pecan *(Carya illinoensis)* in somewhat drier situations.

The true prairie flora of the uplands is quite similar to that of the Glaciated sub-division just described, but with an increasing proportion of southwestern species towards the south. Other conspicuous differences in the two sub-divisions are the absence of most of the characteristic northern plants to which attention was called in the last list, and in the greater variety of trees and shrubs found along the streams.

The prairie flora has been better preserved here than in the northern part of the state, due to the fact that large tracts have

been kept as grazing lands as well as for putting up hay of the native grasses. In the big prairie hay fields of Vernon, Barton, and Jasper counties, as well as along the railways, fine examples of the native flora can be seen. The prairies here are very attractive at different seasons, with a profusion of flowering plants, many of them of brilliant colors. With the first warm days of spring little drabas, March lily *(Erythronium mesochoreum)*, spring beauty, prairie anemone *(Anemone caroliniana)*, buttercups, violets, and bluets *(Houstonia minima)* begin to appear; and these are followed quickly by wild hyacinth *(Camassia hyacinthina)*, spiderwort *(Tradescantia canaliculata)*, wild roses, blue-, yellow-, and white-flowered wild indigo *(Baptisia vespertina, B. leucophaea,* and *B. leucantha)*, bush clover, prairie clover *(Petalostemum purpureum* and *P. candidum)*, wild senna, shooting star, phlox, Indian blanket, larkspur *(Delphinium Penardi)*, gromwell *(Lithospermum canescens* and *L. angustifolium)*, and coreopsis *(Coreopsis grandiflora)*. Later come butterfly-weed, milk-weed, horsemint, gerardias, wine cups *(Callirhoë digitata)*, blazing star *(Liatris scariosa* and *L. pycnostachya)*, ironweeds, rosinweeds, and many species of asters and solidagos.

On the Barton upland, in the southwestern part of Barton County and the northwestern part of Jasper County, a number of peculiar plants have been found, some of which are known nowhere else in the state. The upland prairies here have a sandy soil, with blocks of residual sandstone scattered over the surface and ledges sometimes outcropping, producing little glades or barrens; and along the small intermittent streams are small boggy areas with an acid type of soil. Some of the plants found here are *Andropogon ternarius, Setaria geniculata, Panicum scoparium, Rynchospora capitellata, R. cymosa, Scleria ciliata, Scirpus carinatus, Carex arkansana, Juncus interior, J. effusus* var. *solutus, J. validus, J. nodatus, Geocarpon minimum, Anemone caroliniana, Ranunculus oblongifolius, Crotonopsis elliptica, Saxifraga texana, Rhexia interior, Marshallia caespitosa,* and *Chrysopsis pilosa.*

CHARACTERISTIC PLANTS OF THE UNGLACIATED SUB-DIVISION OF THE PRAIRIE REGION

Sagittaria ambigua	*Rubus Bushii*
Andropogon saccharoides	*Ammannia auriculata*
Sporobolus ozarkanus	*Lotus americanus*
Tripsacum dactyloides	*Rotala ramosior* var. *interior*
Panicum scoparium	*Rhexia interior*
Schedonnardus paniculatus	*Asclepias syriaca* var. *kansana*
Koeleria cristata	*Sabatia campestris*
Fimbristylis autumnalis	*Lobelia spicata* var. *hirtella*
Carex oklahomensis	*Agalinis fasciculata*
Carex Bicknellii	*Gutierrezia dracunculoides*
Juncus validus	*Solidago gymnospermoides*
Erythronium mesochoreum	*Helianthus salicifolius*
Sisyrinchium campestre var. *kansanum*	*Artemisia vulgaris* var. *ludoviciana*
Anemone caroliniana	*Marshallia caespitosa*
Draba reptans	*Aster paludosus*

Many of the most abundant and striking plants of the unglaciated prairies are of wide distribution throughout the state and therefore cannot be included amongst the distinctive plants of the sub-division, although, since they often dominate the flora and give character to it, they are in a sense characteristic. Most conspicuous amongst these may be mentioned *Andropogon scoparius* var. *frequens*, *A. provincialis*, *Sorghastrum nutans*, *Tradescantia canaliculata*, *Camassia hyacinthina*, *Ranunculus fascicularis*, *Delphinium Penardi*, *Rosa setigera* var. *tomentosa*, *Desmanthus illinoensis*, *Schrankia uncinata*, *Cassia fasciculata*, *Baptisia leucophaea*, *B. leucantha*, *Petalostemum purpureum*, *P. candidum*, *Astragalus mexicanus*, *Amorpha canescens*, *Desmodium illinoense*, *D. canadense*, *D. sessilifolium*, *Lespedeza capitata*, *Linum medium*, *Polygala incarnata*, *Croton capitatus*, *Euphorbia corollata*, *Callirhoë digitata*, *Viola sagittata*, *Jussiaea diffusa*, *Gaura biennis*, *Oenothera biennis*, *Eryngium yuccifolium*, *Ptilimnium Nuttallii*, *Cicuta maculata*, *Polytaenia Nuttallii*, *Apocynum cannabinum*, *Asclepiodora viridis*, *Asclepias tuberosa*, *A. incarnata*, *A. verticillata*, *Acerates viridiflora*, *A. hirtella*, *Phlox pilosa*, *Lithospermum canescens*, *L. angustifolium*, *Verbena stricta*, *V. canadensis*, *Physostegia virginiana*, *Monarda mollis*, *Castilleja coccinea*, *Pentstemon tubiflorus*, *P. Digitalis*, *Houstonia*

minima, Vernonia crinita, V. Baldwini, V. missurica, Liatris scariosa, L. pycnostachya, Solidago glaberrima, S. speciosa, S. altissima, Aster praealtus, A. ericoides var. *prostratus, Antennaria plantaginifolia, Silphium laciniatum, S. integrifolium, Rudbeckia subtomentosa, Echinacea pallida, Ratibida pinnata, Helianthus rigidus, H. mollis, H. grosse serratus, H. hirsutus, Coreopsis tripteris, C. palmata,* and *Cacalia tuberosa.*

Besides the main plant regions and their sub-divisions and the isolated colonies of relic plants which have been described, a number of species have been found only in a single locality or in a few widely separated localities in the state, and several others seem to be confined to a single geological formation.

Thelypteris spinulosa, Saxifraga pensylvanica var. *Forbesii,* and *Sullivantia renifolia* have been found only on outcrops of St. Peter sandstone, near the Mississippi and Missouri Rivers from Jefferson to Montgomery counties. Somewhat farther south in the Iron Mountain area, *Dennstaedtia punctilobula, Lycopodium complanatum* var. *flabelliforme, Goodyera pubescens,* and *Viola pallens* are known only very locally on the La Motte sandstone. *Pedicularis lanceolata,* a species which is usually known only from much farther north than Missouri, west of the Mississippi, has been found in acid bogs in Iron, Shannon, Morgan, and Greene counties. In the central part of the Ozark region *Silene Wherryi,* a plant of the southern Appalachians, has been collected in Phelps, Pulaski, Dent, Douglas, Shannon, Texas, and Laclede counties, where it grows in cherty woods. *Zigadenus Nuttallii* and *Eriogonum longifolium* have been found only in Oregon County. In the limestone glades of Jackson and Cass counties *Cogswellia daucifolia* is locally abundant, although it is known from no other locality in the state. The general range of this species is westward through Nebraska to Texas, and it is a curious fact that *Clematis Fremontii,* with a similar general range, has been found only in limestone glades on the opposite side of the state. *Geocarpon minimum,* a very interesting little plant both because of its rarity and also because it seems to be in some respects a connecting link between the plant families

Aizoaceae and Caryophyllaceae, was discovered in sandstone glades in Jasper County, and it is so far known from no other locality. *Epipactis latifolia* has been found in the same county, and this is apparently the only record for this species west of Pennsylvania. There seems to be no doubt that it is native at this station. *Amsonia ciliata* var. *tenuifolia* is growing abundantly in glades of the bald knob type in Ozark and Douglas counties, and these are also the only known localities for it in the state. Mention has already been made of a number of other similar instances in describing the Jam-up Bluff locality of Shannon County and the glades and bald knobs of other parts of the state, and the list of such species could probably be considerably lengthened.

Several distinctly southern or coastal species of the Southeastern lowlands again appear in the extreme southwestern part of the state. Amongst these are *Scirpus carinatus, Paspalum floridanum, Triodia stricta, Leersia lenticularis, Melothria pendula, Mecardonia acuminata,* and *Agalinis viridis.* Some of these wide gaps in distribution may be filled in by future discoveries, and in some cases at least they would seem to indicate a former wider distribution of the species in the intervening areas.

More than 10 per cent of the plants included in the present catalogue have been introduced into the state since the settlement of the country by Europeans. Most of these are weeds or grasses that grow in waste places or in cultivated ground. Many of them have become thoroughly established and common, and in some cases they are crowding out to a great extent the native species which find themselves unable to compete with them. Some of our introduced plants were formerly cultivated for their supposed medicinal value or for other uses, and others were first grown as ornamental plants in old gardens. The day-lily, blackberry lily, Queen Anne's lace, hoarhound, catnip, motherwort, matrimony-vine, Gill-over-the-ground, butter-and-eggs, bouncing Bet, and teasel are familiar examples of these.

Most of the introduced plants are very adaptable and con-

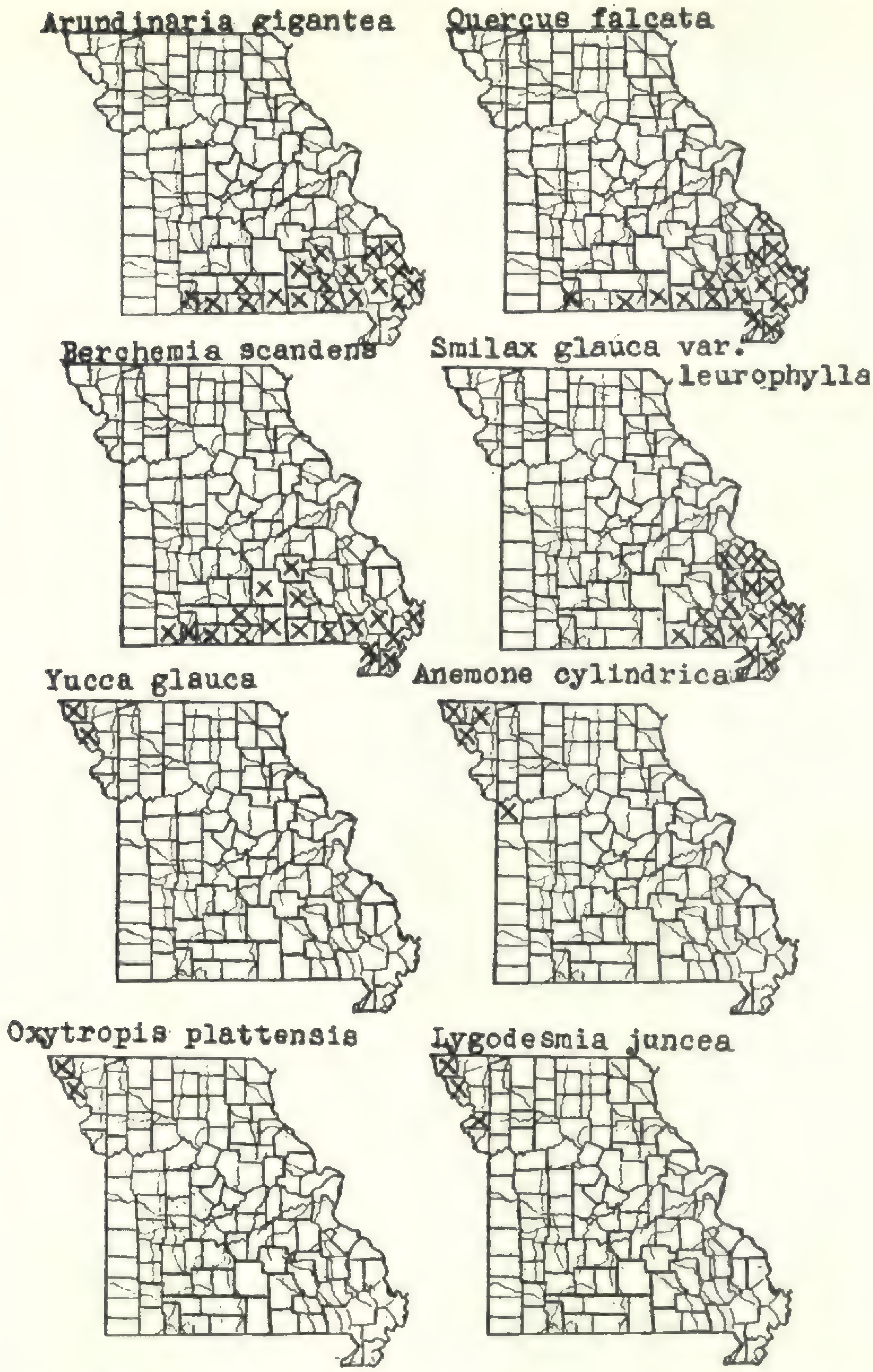

Fig. 3. Showing occupation of three species in the Southeastern lowlands and in the White and Current River systems (first three maps); of *Smilax glauca* in the Southeastern lowlands; and of four species in the loess mounds (lower four maps). Since the maps were made, *Arundinaria gigantea* has been found in Pemiscot, Dunklin, Barry, and McDonald counties, and *Quercus falcata* in Barry Co.

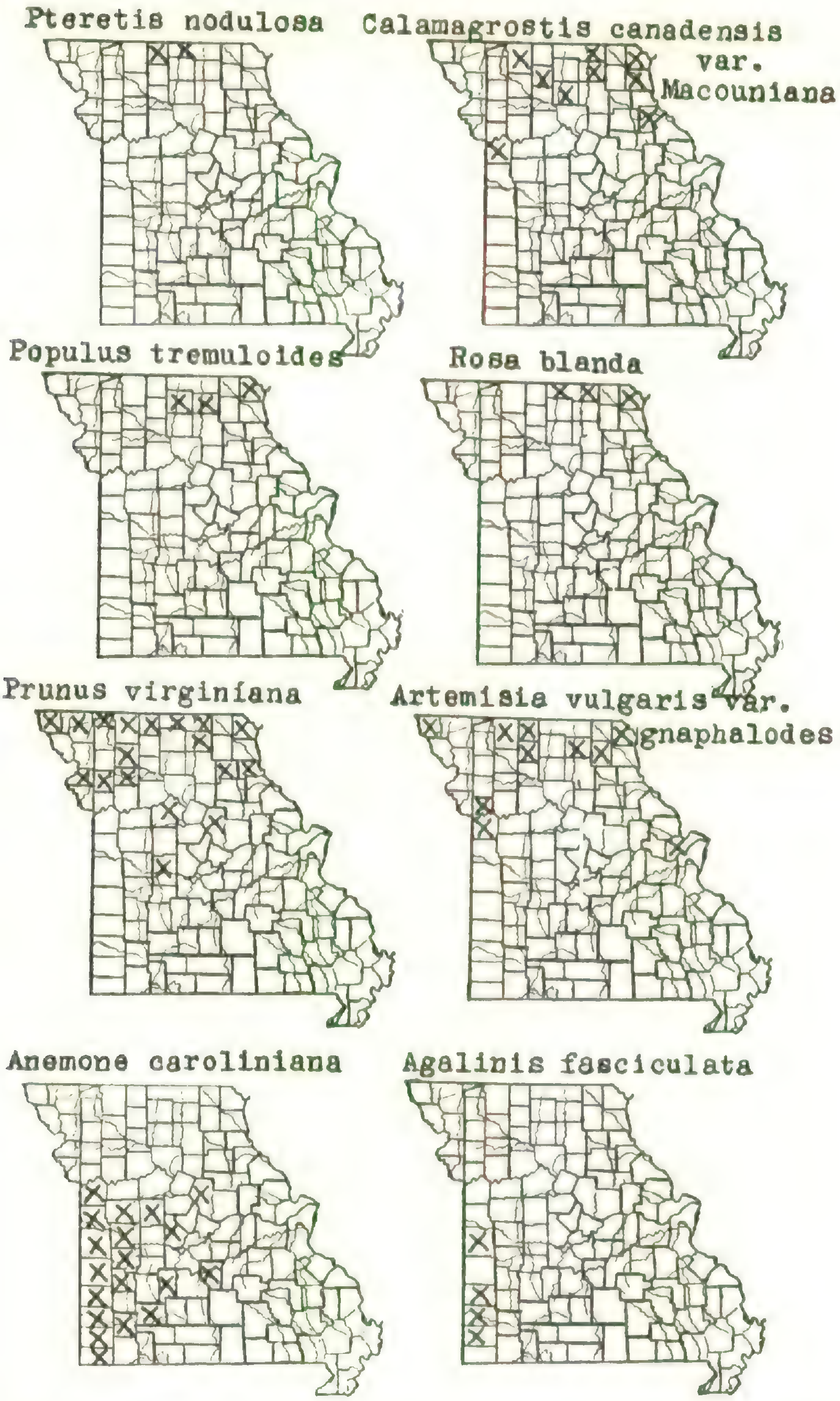

Fig. 4. Showing occupation of species in the glaciated prairie region of northern and central Missouri (upper six maps); of two species in the unglaciated region (lowest two maps).

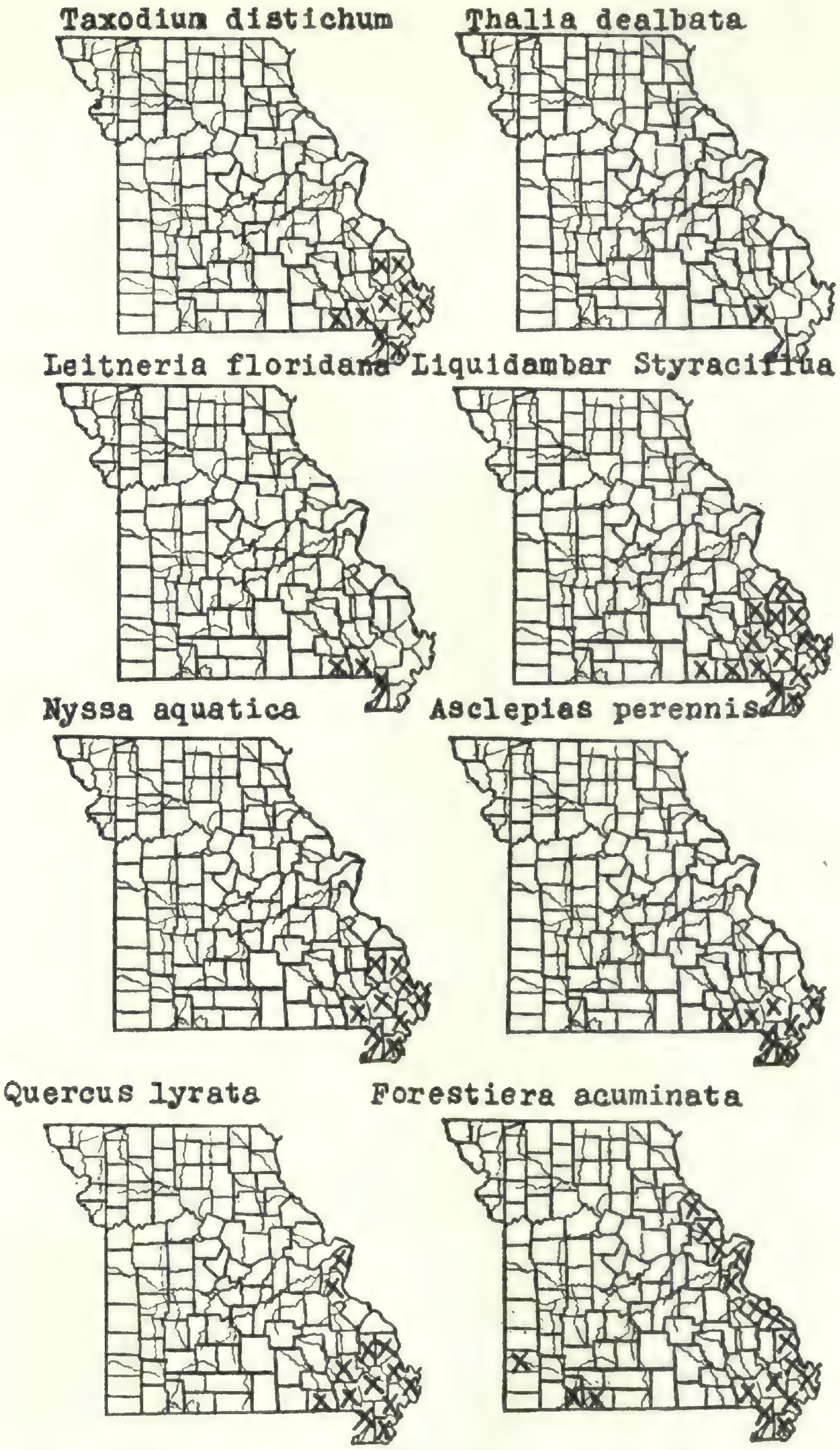

Fig. 5. Showing occupation of species in the Southeastern lowlands (upper six maps); species extending outside the limits of this region (lowest two maps).

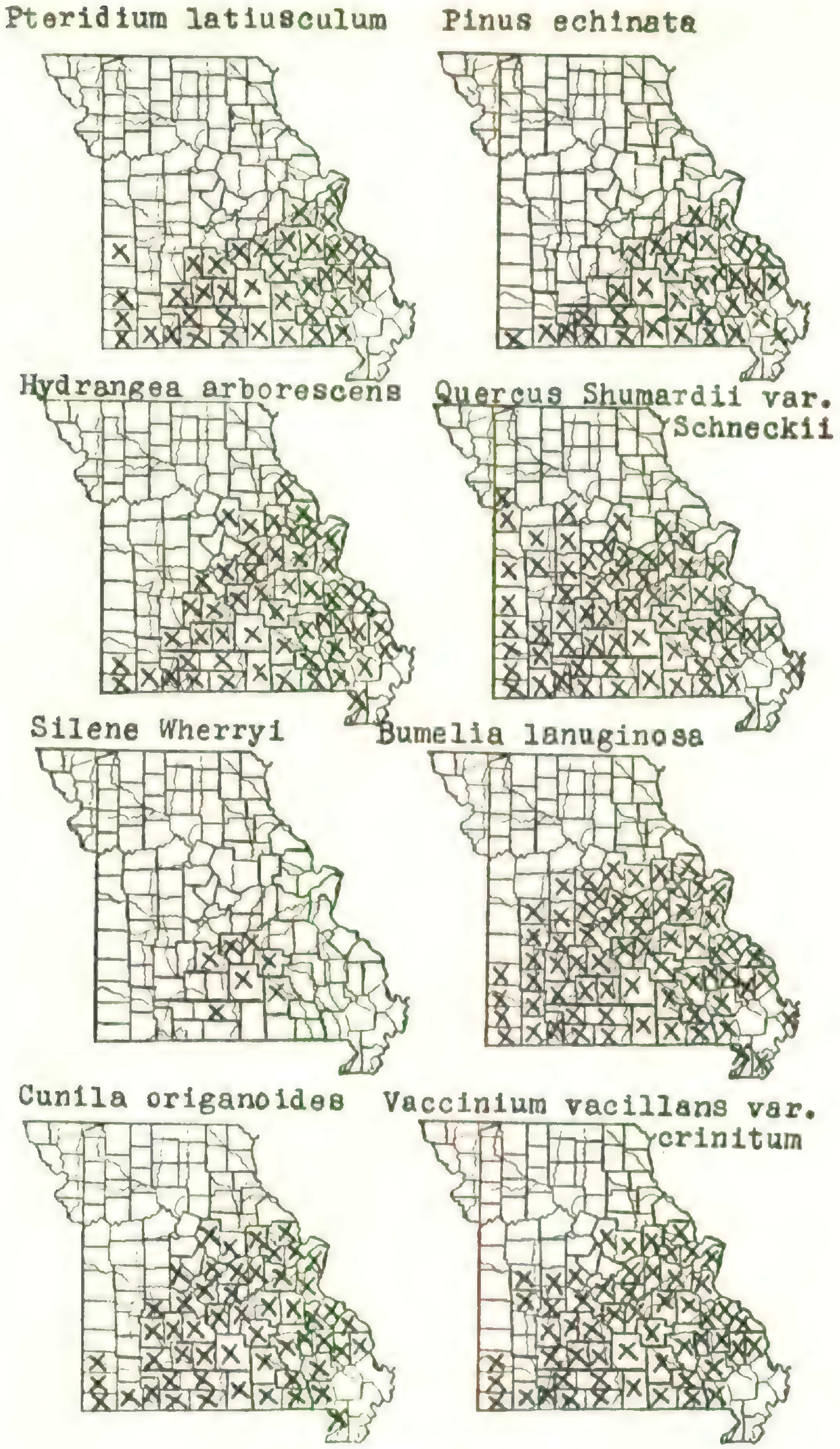

Fig 6. Distribution of eight species occupying the Ozark region.

sequently they are not restricted to any type of soil, and their distribution has little significance or relation to the native flora. In a few cases, however, they seem to be limited to certain areas or environments and to show little disposition to spread beyond them. Amongst such plants are the Japanese clover *(Lespedeza striata)*, common only in rocky ground in the Ozark region although sometimes found elsewhere, *Heliotropium indicum* and *Perilla frutescens* that seem inclined to spread only in the southern counties, the teasel, which seems to establish itself mainly along rocky stream beds in the eastern and southern counties, and the recently introduced *Tamarix gallica*, which, judging by its behavior in other sections, is likely to spread along the margins of the great rivers but scarcely beyond them. Southern species, such as *Arundo Donax* and the water hyacinth *(Eichhornia crassipes)*, if they persist will probably be confined to the Southeastern lowlands.

The number and relative proportion of introduced plants tend constantly to increase as the country becomes more thickly settled and as means of transportation and communication multiply. Many of them have been brought in by railroads, either in ballast or merchandise or in the cleanings of cars, and new immigrants are often first noticed along railways or about railroad centers. Although some of them show little tendency to spread far beyond the place of introduction, others extend their range rapidly and in a few years cover large sections or all parts of the state. The rapid spread in recent years of the white- and yellow-flowered sweet clover and of *Torilis Anthriscus* and *Helenium tenuifolium* is a good example of this.

The great majority of our weed immigrants are of European origin; others came originally from Asia, and a few from South America or other parts of the world. Some weedy species, and others that would scarcely be called weeds, have been introduced into the state from the West or from other parts of North America, and in some cases species that are native in one part of the state have been introduced into other sections where they are now established. This is sometimes

confusing in considering the natural distribution of species and its significance, and attention is called to some of these in the notes accompanying the catalogue.

Species which are found native in some part of the United States are printed in bold-face type, while the introduced species (i. e., native of some country other than the United States) appear in Roman capitals.

The maps and descriptions of the different plant regions of the state, with the lists of characteristic plants found in them, will serve to give some idea of the diversity and richness of the flora of Missouri and of the varied elements that enter into it.

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Annotated List of Missouri Plants

SPERMATOPHYTA

Fam. Pinaceae

Pinus echinata Mill. Southern Yellow Pine.

Dry uplands, rocky slopes and bluffs, and sometimes alluvial woods along streams, in sandstone, chert, granitic or porphyritic trachyte areas, in mixed growth with deciduous trees or locally in pure stands. Oxylophile. Southern Mo., south of a line from Franklin to McDonald counties: Franklin, Jefferson, Washington, Ste. Genevieve, Perry, Bollinger, Madison, Wayne, St. Francois, Butler, Iron, Reynolds, Shannon, Carter, Ripley, Oregon, Howell, Crawford, Texas, Dent, Phelps, Pulaski, Wright, Douglas, Ozark, Taney, Stone, Christian, Barry, and McDonald counties.

The Austrian pine, *Pinus nigra* Arnold, has been found locally established in woods in St. Louis Co., and the scrub pine, *Pinus virginiana* Mill., has been found in woods and open slopes in Callaway Co. The Scotch pine, *Pinus sylvestris* L., and the white pine, *Pinus Strobus* L., are often planted but do not appear to establish themselves away from cultivation, and should not be considered as additions to the state flora.

Taxodium distichum (L.) Richard. Bald Cypress.

Swamps, bayous, and flood plains of streams. Oxylophile to circumneutral. Southeastern Mo.: Cape Girardeau, Bollinger, Scott, Mississippi, Stoddard, New Madrid, Pemiscot, Dunklin, Butler, and Ripley counties.

Juniperus virginiana L. Red Cedar.

Glades, bluffs, and borders of woods, on limestone or dolomite, and rarely on siliceous or granitic rocks. Calciphile to circumneutral. General, but commonest in the Ozark region.

Juniperus virginiana var. **crebra** Fernald & Griscom, Rh. **37**: 133. 1935.

Borders of woods and glades or bluffs. Circumneutral. Eastern Mo.: Lewis and Jefferson counties.

Juniperus mexicana Spreng. White Cedar.

Juniperus Ashei Buchholz, Bot. Gaz. **90**: 329, *figs. 1, 2.* 1930.

Juniperus sabinoides Nees.

Glades and dolomite bluffs of White River. Calciphile. Southwestern Mo.: Barry Co.

Fam. TYPHACEAE

Typha latifolia L. Common Cat-tail.

Swamps and muddy margins of ponds and streams. Circumneutral. General.

Typha angustifolia L. Narrow-leaved Cat-tail.

Muddy borders and in shallow water of saline spring-fed lake. Calciphile. Local: Saline Co. This has often been confused with narrow-leaved and slender-spiked forms of *T. latifolia.*

Fam. SPARGANIACEAE

Sparganium eurycarpum Engelm. Bur-reed.

Swamps and borders of ponds and streams. Circumneutral. General but not common: St. Charles, St. Louis, Clay, and Jackson counties.

Sparganium americanum Nutt. See Rh. **24**: 27, 33. 1922. Bur-reed.

Sparganium androcladum of auth., not Morong (B & B).

Sparganium americanum var. *androcladum* Fernald & Eames, not *S. simplex* var. *androcladum* Engelm. (G).

In spring branches and margins of streams and swales. Circumneutral to calciphile. Southern and central Mo.: St. Louis, Jefferson, St. Francois, Bollinger, Ripley, New Madrid, Dunklin, Reynolds, Carter, Phelps, Dent, Shannon, Texas, Howell, Camden, Jackson, Greene, Jasper, and Newton counties.

Sparganium androcladum (Engelm.) Morong. See Rh. 24: 27, 32. 1922. Bur-reed.

Sparganium lucidum Fernald & Eames (G), (B & B).

Borders of ponds and swales. Circumneutral. Southern and central Mo.: St. Louis, Jefferson, Iron, St. Francois, Scott, Dunklin, Boone, Cass, Greene, and Jackson counties.

Fam. Najadaceae

Potamogeton pulcher Tuckerm. Spotted Pondweed.

Slow streams and ponds. Circumneutral. Eastern Mo., south of the Missouri River: St. Louis, Jefferson, Franklin, Dent, Texas, Shannon, Iron, and Ripley counties. This species has sometimes been confused with *Potamogeton natans* which is not known in Mo.

Potamogeton amplifolius Tuckerm. Large-leaved Pondweed.

Sloughs, streams, ponds, spring branches, and in lakes fed by cold springs. Circumneutral. Southern and central Mo.: Dallas, Morgan, Camden, Howell, Texas, Douglas, and Ozark counties.

Potamogeton illinoensis Morong.

Sloughs and slow waters along streams. Circumneutral. Southeastern Mo., local: Ripley Co. This species has sometimes been confused with *Potamogeton americanus,* a common species in Mo.

Potamogeton americanus Cham. & Schlecht. Long-leaved Pondweed.

Ponds and rivers. Circumneutral. Southern and central Mo.: St. Louis, Jefferson, Franklin, St. Francois, Iron, New Madrid, Dunklin, Ripley, Gasconade, Osage, Pulaski, Camden, Miller, Laclede, Taney, Jackson, Jasper, and Newton counties.

Potamogeton lucens L. Shining Pondweed.

Slow-flowing streams, springs, and spring branches, and in lakes fed by cold springs. Circumneutral to calciphile. Southeastern and middle Mo.: Perry, Iron, Wayne, Dunklin, Reynolds, Shannon, Carter, Pulaski, and Laclede counties.

POTAMOGETON CRISPUS L. Curly Muck-weed.

Ponds, sloughs, and lakes fed by cold springs. Circumneutral. Southern Mo.: Crawford and Newton counties.

Potamogeton foliosus Raf. var. **genuinus** Fernald, Mem. Am. Acad. 17: 43. 1932.

Streams, springs, and ponds. Circumneutral to calciphile. General: St. Louis, Wayne, Butler, Shannon, Carter, Reynolds, Oregon, Howell, Macon, Boone, Morgan, Camden, Pulaski, Laclede, Dallas, Wright, Greene, Christian, Ozark, Douglas, Platte, Clay, Jackson, Bates, Jasper, and Barry counties.

Potamogeton foliosus var. **macellus** Fernald, Mem. Am. Acad. 17: 46. 1932.

Potamogeton foliosus Raf. in part (G).

Similar situations to the preceding. Circumneutral to calciphile. Southern, central, and western Mo.: St. Louis, Butler, Crawford, Reynolds, Boone, Miller, Laclede, Howell, Platte, Bates, Jasper, and Christian counties.

Potamogeton panormitanus Bivona-Bernardi var. **major** G. Fischer.

Slow streams and ponds. Circumneutral. Middle Mo., local: Benton Co.

Potamogeton panormitanus var. **minor** Biv.

Slow streams. Circumneutral. Southern Mo.: Perry and Laclede counties.

Potamogeton diversifolius Raf. See Mem. Am. Acad. **17**: 105–106. 1932. Pondweed.

Potamogeton dimorphus of Am. auth. in part, not Raf. (G), (B & B).

Potamogeton Spirillus of Am. auth. in part, not Tuckerm.

Potamogeton hybridus of Am. auth. in part, not Michx. (G).

Streams and ponds. Circumneutral. General: Scotland, Monroe, Audrain, Callaway, St. Louis, Bollinger, Wayne, Butler, Dent, Shannon, Oregon, Caldwell, Ray, Clay, Jackson, Henry, Greene, Wright, Webster, Ozark, Taney, and Jasper counties.

Potamogeton pectinatus L. Fennel-leaved Pondweed.

Ponds and streams. Calciphile to circumneutral. General but scattered: St. Louis, Perry, Ripley, Osage, Phelps, Saline, Atchison, Buchanan, and Platte counties.

Potamogeton rotundatus Hagst.

Ponds and slow streams. Circumneutral. Local: St. Louis Co.

Najas guadalupensis (Spreng.) Morong. See Rh. **25**: 107. 1923. Naiad.

Marshes and shallow water of streams. Circumneutral. Central and southern Mo.: St. Louis, St. Francois, Iron, Reynolds, Ripley, Phelps, Dent, Shannon, Texas, Boone, Laclede, Greene, Platte, Jackson, and Vernon counties.

Zannichellia palustris L. Horned Pondweed.

Marshy and springy ground, and in ponds and shallow streams, frequently in saline marshes and springs. Calciphile to circumneutral. General but scattered: Clark, St. Louis, Jefferson, Perry, Randolph, Cooper, Saline, Maries, Miller, Dent, Reynolds, Carter, Oregon, Texas, Crawford, Laclede, Dallas, Jackson, and Newton counties.

Ruppia maritima L. var. **rostrata** Agardh. Ditch-grass.

Ponds and shallow streams. Local: Henry Co.

Fam. ALISMACEAE

Sagittaria longirostra (M. Micheli) J. G. Smith. Long-beaked Arrow-head.

Scattered and uncommon: Henry and Jasper counties.

All of the Missouri species of *Sagittaria* are found in shallow water or on muddy borders of sloughs, ponds, and sluggish streams, most frequently in circumneutral or alkaline soils.

Sagittaria latifolia Willd. Broad-leaved Arrow-head.

General and common.

Sagittaria latifolia f. **obtusa** (Muhl.) Robinson.

Frequent with the typical form. General.

Sagittaria brevirostra Mack. & Bush. Short-beaked Arrow-head.

General and common.

Sagittaria ambigua J. G. Smith. Lance-leaved Sagittaria.

Southwestern Mo.: Barton, Jasper, and Newton counties.

Sagittaria heterophylla Pursh.

Scattered: Callaway, Boone, Jackson, Dent, Texas, Howell, Wright, Ozark, Webster, and Greene counties.

Sagittaria heterophylla var. **elliptica** Engelm.

Scattered: St. Louis and Boone counties.

Sagittaria heterophylla var. **angustifolia** Engelm.

Scattered: Greene and Texas counties.

Sagittaria graminea Michx. Grass-leaved Sagittaria.

General but scattered: St. Louis, Butler, Texas, Carroll, Jackson, Jasper, Lawrence, Greene, and Taney counties.

Sagittaria platyphylla (Engelm.) J. G. Smith.

Southeastern Mo.: Dunklin and Butler counties.

Lophotocarpus calycinus (Engelm.) J. G. Smith.

Shallow water and muddy margins of sloughs, ponds, and sluggish streams. Calciphile to circumneutral. General.

Echinodorus tenellus (Martius) Buchenau. Bur-head.

Wet ground about ponds and sloughs. Circumneutral. Local: St. Louis Co.

Echinodorus cordifolius (L.) Griseb. Bur-head.

Swamps and muddy banks. Circumneutral. Scattered, mostly along the larger rivers: Lincoln, St. Louis, Franklin, Mississippi, Ripley, and Jackson counties.

Echinodorus cordifolius var. **lanceolatus** (Engelm.) Mack. & Bush.

Similar situations to the preceding. Circumneutral. Scattered: Clay and Jackson counties.

Echinodorus radicans (Nutt.) Engelm. Creeping Bur-head.

Swamps and wet woods. Circumneutral. Southeastern Mo., and north along Mississippi River: St. Louis, Jefferson, Stoddard, New Madrid, Dunklin, and Butler counties.

Alisma subcordatum Raf. See Arkiv f. Bot. **24A**^{7}: 19. 1932. Water Plantain.

Alisma Plantago-aquatica of Am. auth. in part, not L. (G).

Swamps and muddy borders of sloughs, ponds, and sluggish streams. Circumneutral. General. This has been confused with *Alisma Plantago-aquatica* and subsp. *brevipes* (as defined by Samuellson) which do not occur in Mo.

Vallisneria americana Michx. See Rh. **20**: 108. 1918. Eel-grass.

Vallisneria spiralis of Am. auth., not L. (G), (B & B).

Slow streams. Circumneutral. Eastern Mo., south of the Missouri River: St. Louis, Jefferson, Franklin, Gasconade, Phelps, Iron, Butler, Carter, and Ripley counties.

Fam. HYDROCHARITACEAE

Anacharis occidentalis (Pursh) Victorin, Contr. Lab. Bot. Univ. Montreal, No. 18: 40. 1931; see also Rh. 34: 114–116. 1932. Water-weed.

Elodea canadensis Michx. in part (G).

Philotria canadensis (Michx.) Britton in part (B & B).

Ponds, pools, and sloughs, on the surface of stagnant water, in springs and spring branches, and margins of streams. Circumneutral to calciphile. South-

ern and central Mo.: Boone, Lincoln, St. Charles, St. Louis, Jefferson, Crawford, Madison, Reynolds, Carter, Butler, Dunklin, Ripley, Oregon, Shannon, Texas, Osage, Cole, Miller, Phelps, Pulaski, Dallas, Camden, Laclede, Wright, Douglas, Ozark, Jackson, and Jasper counties.

Limnobium Spongia (Bosc) Richard. American Frog-bit.
Streams and sloughs. Circumneutral. Southeastern Mo., local: Dunklin Co.

Fam. GRAMINEAE

Arundinaria gigantea (Walt.) Chapm. See Am. Jour. Bot. **21**: 127. 1934; also Bull. Torr. Bot. Club **56**: 315–318. 1929. Switch Cane, Giant Cane.
Arundinaria macrosperma Michx. (G), (B & B), in part.
Arundinaria tecta (Walt.) Muhl. (G), (B & B), in part.
Low wet woods and moist ground along bluffs. Circumneutral. Southern Mo., mostly in the southeastern lowlands and along White River and its tributaries: Bollinger, Cape Girardeau, Scott, Mississippi, Stoddard, New Madrid, Pemiscot, Dunklin, Butler, Wayne, Ripley, Carter, Reynolds, Oregon, Shannon, Howell, Douglas, Ozark, Taney, Stone, Barry, and McDonald counties.

Bromus breviaristatus Buckley.
Introduced in Jackson Co.

Bromus catharticus Vahl. See Am. Jour. Bot. 21: 127. 1934.
Bromus unioloides (Willd.) HBK. (B & B).
Waste ground. Western Mo., local: Jackson Co.

BROMUS INERMIS Leyss. Hungarian Brome Grass.
Introduced in fields, waste ground, and roadsides. Scattered: St. Louis, Boone, Jackson, and McDonald counties.

BROMUS TECTORUM L.
Introduced in fields and waste ground. Indifferent. General.

Bromus purgans L. Wild Chess.
Rocky or rich woods and bluffs. Circumneutral to calciphile. General.

Bromus latiglumis (Scribn.) Hitchc. See Rh. **35**: 316. 1933.
Bromus purgans var. *latiglumis* (Scribn.) Shear.
Bromus altissimus Pursh, not Gilib. (G).
Woods and bluffs. Calciphile. Eastern Mo.: Clark, St. Louis, and Jefferson counties.

Bromus latiglumis f. **incanus** (Shear) Fernald, Rh. **35**: 316. 1933.
Bromus altissimus **f.** *incanus* (Shear) Wiegand.
Bromus incanus (Shear) Hitchc. (G), (B & B).
Wooded banks. Calciphile. Western Mo.: Jackson Co.

BROMUS SECALINUS L. Chess, Cheat.
Fields and waste ground. Indifferent. General.

BROMUS MOLLIS L. See Am. Jour. Bot. **21**: 128. 1934. Soft Chess.
Bromus hordeaceus of auth., not L. (G), (B & B).
Introduced in waste ground and along railways. Scattered: St. Louis and Jackson counties.

BROMUS RACEMOSUS L. See Rh. **24**: 90. 1922.

Introduced along roadsides, railways, and in waste ground. Indifferent. Scattered: St. Louis, Jackson, Vernon, and Jasper counties.

BROMUS COMMUTATUS Schrad. See Rh. **24**: 90. 1922.

Introduced in fields and waste ground. Indifferent. Scattered: Iron, Boone, Clay, Jackson, Webster, and Jasper counties.

BROMUS ARVENSIS L. Field Chess.

Introduced in fields and waste ground. Indifferent. Scattered: Lewis, Audrain, Jefferson, Boone, Dekalb, Jackson, and Jasper counties.

BROMUS JAPONICUS Thunb.

Introduced in fields, waste ground, and roadsides. Indifferent. Scattered: Boone and Jackson counties.

Festuca octoflora Walt. Slender Fescue Grass.

Fields, prairies, glades, rocky open or dry woods, and waste ground. Oxylophile. Southern and central Mo. south and east of a line drawn from St. Louis and Morgan counties to Vernon Co.

Festuca octoflora var. **tenella** (Willd.) Fernald, Rh. 34: 209. 1932.

Similar situations to the preceding. Oxylophile. General and common. This is the commonest variety found in Mo.

Festuca octoflora var. **glauca** (Nutt.) Fernald, Rh. 34: 209. 1932.

Similar situations to the preceding. Oxylophile. Southern and central Mo. south and east of a line drawn from St. Louis, Callaway, and Morgan counties to Vernon Co.

Festuca sciurea Nutt.

Rocky or sandy open ground. Oxylophile to circumneutral. Southern Mo., scattered: Dunklin and Jasper counties.

FESTUCA ELATIOR L. Meadow Fescue.

Meadows, open woods, and waste ground. Circumneutral. General.

Festuca obtusa Spreng.

Festuca nutans Spreng. (G), (B & B).

Rocky or rich woods, bluffs, alluvial ground along streams, and waste ground. Circumneutral. General.

Festuca Shortii Kunth.

Moist open ground and woods. Circumneutral. General but scattered: Clark, St. Louis, Jefferson, Dent, Shannon, Boone, Jackson, and Jasper counties.

Glyceria acutiflora Torr.

Margins of ponds, in shallow water. Circumneutral. Southern Mo.: Dent, Texas, Howell, Wright, Webster, and Ozark counties.

Glyceria arkansana Fernald, Rh. 31: 49. 1929.

Swampy ground. Circumneutral. Southeastern Mo.: Dunklin, Butler, and Ripley counties.

Glyceria septentrionalis Hitchc. Floating Manna Grass.

Borders of sloughs, wet open woods, and meadows. Circumneutral. Northern and central Mo.: Scotland, St. Louis, Jefferson, Livingston, and Jackson counties.

Glyceria pallida (Torr.) Trin. Pale Manna Grass.

Swampy ground. Circumneutral. Southeastern Mo.: Scott and Butler counties.

Glyceria striata (Lam.) Hitchc. Proc. Biol. Soc. Wash. **41**: 157. 1928. Fowl Meadow Grass.

Glyceria nervata (Willd.) Trin. (G).

Panicularia nervata (Willd.) Kuntze (B & B).

Sloughs, bogs, wet woods, and meadows. Circumneutral. General.

POA ANNUA L. Low Spear Grass, Annual Blue Grass.

Fields, gardens, and waste ground. Indifferent. General and common.

Poa Chapmanniana Scribn.

Prairies, glades, and waste ground. Circumneutral. Central and southern Mo.: St. Louis, Jefferson, Dent, St. Francois, Shannon, Texas, Boone, Jackson, Polk. Greene, Christian, Douglas, Ozark, Stone, Jasper, and Newton counties.

POA COMPRESSA L. Canada Blue Grass, English Blue Grass.

Fields and rocky waste ground. Indifferent. General.

Poa nemoralis L.

Introduced along railroads. Jackson Co.

Poa pratensis L. Kentucky Blue Grass.

Fields, meadows, glades, open woods, and waste ground. Circumneutral to calciphile. General and common.

Poa palustris L. See Rh. **18**: 235. 1916.

Poa triflora Gilib. (G), (B & B).

Wet places and open ground. Circumneutral. Scattered: St. Louis, Ste. Genevieve, and Jackson counties.

Poa sylvestris Gray.

Rich or alluvial woods. Circumneutral. General.

Poa Wolfii Scribn.

Rocky woods, moist ledges, and along streams. Calciphile to circumneutral. Central and southern Mo.: Franklin, Shannon, Texas, Boone, Jackson, Jasper, McDonald, Taney, and Stone counties.

Eragrostis hypnoides (Lam.) BSP. See Rh. **28**: 114. 1926. Creeping Love Grass.

Wet alluvial river banks and margins of sloughs and ponds. Circumneutral. General.

Eragrostis reptans (Michx.) Nees. See Rh. **28**: 114–115. 1926.

Eragrostis Weigeltiana (Reichenb.) Bush (B & B).

Moist alluvial ground along the Missouri River. Circumneutral. Western Mo., local: Jackson Co.

Eragrostis capillaris (L.) Nees. Love Grass.

Fields, clearings, rocky ledges, glades, and waste ground. Indifferent. General and common.

Eragrostis Frankii (Fisch., Mey. & Lall.) Steud.

Waste alluvial and cultivated ground. Circumneutral. General.

ERAGROSTIS CILIANENSIS (All.) Link ex Lutati, Malpighia **18**: 386. 1904; see Hitchcock, Man. Grasses U. S. Misc. Publ. U. S. Dept. Agr. 200: 154. 1935.

Eragrostis megastachya (Koeler) Link (G).

Eragrostis major Host (B & B).

Waste and cultivated ground. Indifferent. General.

ERAGROSTIS POAEOIDES (L.) Beauv. See Hitchcock, Man. Grasses U. S. Misc. Publ. U. S. Dept. Agr. 200: 156. 1935.

Eragrostis minor Host (G), (B & B).

Waste ground. Indifferent. Introduced in Stone Co.

Eragrostis pilosa (L.) Beauv. Indian Love Grass.

Moist banks, rocky open or alluvial or waste ground. Indifferent. General.

Eragrostis pectinacea (Michx.) Nees. See Hitchcock, Man. Grasses U. S. Misc. Publ. U. S. Dept. Agr. 200: 151. 1935.

Eragrostis caroliniana (Spreng.) Scribn.

Eragrostis Purshii Schrad. (B & B).

Alluvial or open ground along streams and waste places. Indifferent. General.

Eragrostis diffusa Buckl. See Hitchcock, Man. Grasses U. S. Misc. Publ. U. S. Dept. Agr. 200: 151. 1935.

Open ground. Introduced in Jackson Co.

Eragrostis hirsuta (Michx.) Nees.

Open ground. Circumneutral. Southwestern Mo.: Jasper Co.

Eragrostis intermedia Hitchc. Jour. Wash. Acad. Sci. **23**: 450. 1933.

Prairies and open ground. Circumneutral. Western Mo., scattered: Jackson and Newton counties. This has been confused with *Eragrostis lugens* which does not reach Missouri.

Eragrostis spectabilis (Pursh) Steud. See Hitchcock, Man. Grasses U. S. Misc. Publ. U. S. Dept. Agr. 200: 163–164. 1935. Purple Love Grass.

Eragrostis pectinacea of Am. auth., not Michx. (G), (B & B).

Eragrostis pectinacea var. *spectabilis* Gray (G).

Sandy or rocky open or waste ground. Oxylophile to circumneutral. General and common.

Eragrostis trichodes (Nutt.) Nash.

Moist open, sandy or rocky ground. Oxylophile. Central and southern Mo.: Ste. Genevieve, Dent, Ozark, Carroll, and Jackson counties.

Diarina festucoides Raf.

Diarrhena diandra (Michx.) Wood (G), (B & B).

Diarrhena americana Beauv.

Low, rich or alluvial woods and river banks. Circumneutral. General but scattered: St. Louis, Jefferson, Franklin, Shannon, Boone, Camden, Gentry, Clinton, Clay, Jackson, Hickory, Jasper, McDonald, Stone, and Taney counties.

Distichlis stricta (Torr.) Rydb. Salt Grass, Alkali Grass.

Along railroads and waste ground. Indifferent. Western Mo.: introduced in Buchanan and Jackson counties.

Uniola latifolia Michx. Spike Grass.

Rocky woods, bluffs, moist thickets and alluvial or rich low woods. Circumneutral to calciphile. General.

DACTYLIS GLOMERATA L. Orchard Grass.

Fields, waste ground, and roadsides. Indifferent, General.

ARUNDO DONAX L. Giant Reed.

Open ground. Escaped from cultivation in Dunklin Co.

Phragmites communis Trin. var. **Berlandieri** (Fournier) Fernald, Rh. 34: 211. 1932. Reed.

Phragmites communis of Am. auth. in part (G), (B & B).

Low ground along streams and ponds. Circumneutral. Northern and west-central Mo.: Macon, Nodaway, Platte, Clay, Jackson, Lafayette, Saline, and Bates counties.

Melica Porteri Scribn.

Rocky wooded bluffs. Calciphile. Western Mo., local: Jackson Co.

Melica mutica Walt. Melic Grass.

Rocky woods and bluffs. Calciphile. General: St. Louis, Jefferson, Madison, Iron, Wayne, Carter, Shannon, Texas, Miller, Hickory, Callaway, Mercer, Dekalb, Jackson, and Jasper counties.

Melica nitens Nutt. Melic Grass.

Rocky woods, glades, and bluffs. Calciphile. General but scattered: St. Louis, Jefferson, Wayne, Oregon, Boone, Camden, Gentry, Clinton, Clay, Jackson, Hickory, Jasper, McDonald, Stone, and Taney counties.

Triodia flava (L.) Smyth. See Hitchcock, Man. Grasses U. S. Misc. Publ. U. S. Dept. Agr. 200: 213, 969. 1935. Tall Red Top, Purple Top.

Tridens flavus (L.) Hitchc. (G), (B & B).

Tricuspis flava (L.) Hubbard.

Open woods, meadows, glades, and waste ground. Circumneutral. General.

Triodia stricta (Nutt.) Benth. See Hitchcock, Man. Grasses U. S. Misc. Publ. U. S. Dept. Agr. 200: 215 and 971. 1935.

Tridens strictus (Nutt.) Nash (G), (B & B).

Tricuspis stricta (Nutt.) Gray.

Prairies and moist open ground. Circumneutral to oxylophile. Southern Mo.: Mississippi, Dunklin, Butler, Dade, Barton, Jasper, and Newton counties.

Triodia elongata (Buckl.) Scribn. See Hitchcock, Man. Grasses U. S. Misc. Publ. U. S. Dept. Agr. 200: 217, 968. 1935.

Tridens elongatus (Buckl.) Nash (B & B).

Tricuspis elongata (Buckl.) Heller.

Rocky bluffs and glades. Calciphile. Southwestern Mo.: Henry, Barry, and McDonald counties.

Triplasis purpurea (Walt.) Chapm. Sand Grass.

Sandy open ground. Oxylophile. Central and southeastern Mo.: St. Louis, Jefferson, Dunklin, and Jackson counties.

AGROPYRON REPENS (L.) Beauv. var. SUBULATUM (Scribn.) Reichenb. See Rh. 35: 183–184. 1933. Quitch Grass, Couch Grass, Quack Grass.

Introduced in fields and waste ground. Indifferent. General.

Agropyron Smithii Rydb. Blue-joint.

Prairies, fields, and waste ground. Indifferent. General but scattered.

Agropyron trachycaulum (Link) Steud. var. **typicum** Fernald, Rh. 35: 169. 1933. Awned Wheat Grass.

Agropyron tenerum Vasey (G), (B & B).

Agropyron caninum var. *tenerum* (Vasey) Pease & Moore.

Introduced in fields and waste ground. Indifferent. Scattered in western Mo.: Jackson and Jasper counties. This has been confused with *Agropyron pseudorepens* which does not occur in Mo.

AEGILOPS CYLINDRICA Host.

Triticum Aegilops Beauv.

Triticum cylindricum Ces., Pass. & Gib.

Introduced along railroad. Jackson Co.

Elymus glaucus Buckley. Blue Wild Rye.

Elymus Mackenzii Bush.

Rocky wooded bluffs. Calciphile. Southwestern Mo.: Jasper, Barry, and Ozark counties. This has been confused with *Elymus Macounii* which does not reach Mo.

Elymus villosus Muhl. See Rh. 35: 195. 1933.

Elymus striatus of Am. auth., not Willd. (G), (B & B).

Open or rocky woods and prairies. Circumneutral to calciphile. General.

Elymus villosus f. **arkansanus** (Scribn. & Ball) Fernald, Rh. 35: 195. 1933.

Elymus striatus var. *arkansanus* (Scribn. & Ball) Hitchc. (G).

Elymus arkansanus Scribn. & Ball (B & B).

Rocky woods. Circumneutral to calciphile. Southern Mo.: Oregon, Greene, Barry, and Jasper counties.

Elymus canadensis L. See Rh. 35: 191. 1933. Nodding Wild Rye.

Elymus robustus var. *vestitus* Wiegand.

Rocky woods and prairies, and waste ground. Circumneutral. General.

Elymus canadensis f. **glaucifolius** (Muhl.) Fernald, Rh. 35: 191. 1933.

Elymus glaucifolius Muhl.

Elymus glaucifolius var. *robustus* (Scribn. & Sm.) Bush.

Elymus glaucifolius var. *crescendus* (Ramaley) Bush.

Elymus robustus Scribn. & Sm. (G).

Rocky open woods, alluvial ground, prairies, and waste places. Circumneutral. General.

Elymus virginicus L. See Rh. 35: 198. 1933. Wild Rye.

Elymus striatus Willd., but not of most recent authors.

Alluvial ground, open woods, and prairies. Circumneutral. General.

Elymus virginicus f. **hirsutiglumis** (Scribn.) Fernald, Rh. 35: 198. 1933.

Elymus virginicus var. *hirsutiglumis* (Scribn.) Hitchc. (G).

Elymus hirsutiglumis Scribn. (B & B).

Open woods and prairies. Circumneutral. General but scattered.

Elymus virginicus var. **jejunus** (Ramaley) Bush, Am. Midl. Nat. 10: 65. 1926.

Elymus jejunus (Ramaley) Rydb. (B & B).

Fields, open woods, and waste ground. Circumneutral. General.

Elymus virginicus var. **submuticus** Hook.
Open woods. Circumneutral. Scattered: Jefferson, Oregon, and Jackson counties.

Elymus virginicus var. **glabriflorus** (Vasey) Bush, Am. Midl. Nat. **10**: 62. 1926.
Elymus glabriflorus (Vasey) Scribn. & Ball (B & B).
Elymus australis var. *glabriflorus* (Vasey) Wiegand.
Open, rocky, rich or alluvial woods, and prairies. Circumneutral. General.

Elymus virginicus var. **glabriflorus** f. **australis** (Scribn. & Ball) Fernald. See Rh. 35: 198. 1935.
Elymus australis Scribn. & Ball (G), (B & B).
Rocky open woods and prairies. Circumneutral. Central and southern Mo.

Sitanion hystrix (Nutt.) J. G. Smith.
Sitanion longifolium J. G. Smith. (G).
Sitanion elymoides Raf. (B & B).
Introduced along railroads. Jackson Co.

Hystrix patula Moench. See Am. Jour. Bot. 21: 133–134. 1934. Bottle-brush.
Hystrix Hystrix (L.) Millsp. (B & B).
Open or rocky woods and dry open or waste ground. Circumneutral to oxylophile. General.

Hordeum jubatum L. Squirrel-tail Grass.
Fields, roadsides, and waste ground. Indifferent. General, except in the Ozark region, but commonest in northern Mo., where native, and probably introduced elsewhere.

Hordeum pusillum Nutt.
Cultivated and waste ground. Indifferent. General.

Hordeum nodosum L. Meadow Barley.
Dry open ground. Indifferent. Eastern Mo., scattered: St. Louis, Jefferson, Franklin, and Phelps counties.

HORDEUM VULGARE L. var. TRIFURCATUM (Schlecht.) Alefeld. Beardless Barley.
Waste ground. Indifferent. Introduced in Jackson Co.

LOLIUM PERENNE L. Perennial Rye Grass.
Introduced in fields, meadows, and waste ground. Indifferent. General.

LOLIUM MULTIFLORUM Lam. Italian Rye Grass.
Introduced in similar situations to the preceding, but less common. Indifferent. Scattered: Boone, Saline, and Jackson counties.

LOLIUM TEMULENTUM L. Darnel.
Introduced in fields and waste ground. Indifferent. Jackson Co.

Koeleria cristata (L.) Pers. Crested Hair Grass.
Prairies and fields. Circumneutral. General.

Sphenopholis obtusata (Michx.) Scribn. Early Bunch Grass.
Open rocky ground and bluffs. Circumneutral to calciphile. General.

Sphenopholis obtusata var. **pubescens** (Scribn. & Merr.) Scribn.
Rocky open ground. Scattered. Southern and east-central Mo.: St. Louis, Jefferson, Shannon, Scott, and Taney counties.

Sphenopholis obtusata var. **lobata** (Trin.) Scribn.
Occasionally found with the typical form.

Sphenopholis intermedia Rydb. See Bartonia 14: 34. 1932; also Am. Jour. Bot. 21: 134. 1934.
Sphenopholis pallens of auth., not *Aira pallens* Spreng.
Moist rocky open ground. Circumneutral. General.

Sphenopholis nitida (Spreng.) Scribn.
Rocky woods. Circumneutral. Southern Mo., scattered: Ste. Genevieve, Ripley, Reynolds, Carter, Douglas, and Wright counties.

Trisetum flavescens (L.) Beauv. Yellow False Oats.
Introduced along railroads. Jackson Co.

AVENA SATIVA L. Oats.
Commonly escaped in waste ground and along railroads and roadsides. Indifferent. General.

AVENA FATUA L. Wild Oats.
Occasionally introduced in waste ground. Scattered.

ARRHENATHERUM ELATIUS (L.) Beauv. Oat Grass.
Fields and waste ground. Introduced. Local: Jasper Co.

HOLCUS LANATUS L. Velvet Grass.
Notholcus lanatus (L.) Nash (B & B).
Introduced along railroads. Jackson Co.

Danthonia spicata (L.) Beauv. Wild Oat Grass.
Rocky prairies, open woods, and glades. Oxylophile. General, but commonest in central and southern Mo.

Calamagrostis canadensis (Michx.) Nutt. var. **typica** Stebbins, Rh. 32: 40. 1930. Blue-joint Grass.
Wet meadows and prairie swales. Circumneutral. Northern and central Mo.: Mercer, Schuyler, Linn, Ralls, St. Louis, Dekalb, and Jackson counties.

Calamagrostis canadensis var. **Macouniana** (Vasey) Stebbins, Rh. 32: 41. 1930.
Calamagrostis Macouniana Vasey (B & B).
Wet meadows. Circumneutral. Northern and central Mo.: Clark, Lewis, Ralls, Schuyler, Adair, Grundy, Harrison, and Jackson counties.

Calamagrostis inexpansa Gray var. **brevior** (Vasey) Stebbins, Rh. **32**: 50. 1930.
Calamagrostis inexpansa Gray, in part (G), (B & B).
Low wet woods. Circumneutral. Rare and local. Southern and central Mo.: Jackson and Texas counties.

Calamovilfa longifolia (Hook.) Hack. Long-leaved Reed Grass.
Low sandy open ground. Oxylophile to circumneutral. Central Mo.: St. Louis, Jefferson, Clay, and Jackson counties.

AGROSTIS SPICA-VENTI L.
Apera spica-venti (L.) Beauv. (G), (B & B).
Waste ground. Introduced in Jackson Co.

AGROSTIS INTERRUPTA L.
Waste ground. Introduced in St. Louis Co.

AGROSTIS STOLONIFERA L. See Rh. **35**: 317. 1933.

Agrostis alba of auth., not L. (G), (B & B).

Fields and waste ground. Indifferent. General and common.

AGROSTIS TENUIS Sibth.

Agrostis alba var. *vulgaris* (With.) Thurb. (G).

In similar situations to the preceding. Indifferent. General and common.

Agrostis Elliottiana Schultes.

Open sandy or cherty ground, sterile fields, prairies, and glades. Oxylophile. East-central and southern Mo.: Lincoln, Montgomery, St. Louis, Jefferson, St. Francois, Iron, Ste. Genevieve, Madison, Bollinger, Dunklin, Butler, Wayne, Shannon, Dent, Crawford, Washington, Phelps, Maries, Pulaski, Gasconade, Franklin, Texas, Miller, Laclede, Christian, Webster, Barry, Jasper, and McDonald counties.

Agrostis scabra Willd. See Rh. **35**: 207. 1933. Hair Grass, Tickle Grass.

Agrostis hyemalis of auth., not Walt. (G), (B & B).

Fields, meadows, and open woods. Oxylophile to circumneutral. General.

Agrostis perennans (Walt.) Tuckerm. Thin Grass.

Fields, prairie swales, margins of streams and ponds, low or rich woods, and moist open ground. Circumneutral. General.

Agrostis perennans var. **aestivalis** Vasey. See Rh. **35**: 318. 1933.

Agrostis Schweinitzii Trin. (B & B).

Wooded banks, slopes, rich shaded woods, and along streams. Circumneutral. General.

Cinna arundinacea L. Wood Reed Grass.

Wet woods and meadows. Circumneutral. General.

ALOPECURUS PRATENSIS L. Meadow Fox-tail Grass.

Fields, meadows, and waste ground. Indifferent. Scattered: St. Louis and Boone counties.

Alopecurus carolinianus Walt. See Am. Jour. Bot. **21**: 136. 1934.

Alopecurus geniculatus of auth., not L. (G), (B & B).

Alopecurus geniculatus L. var. *ramosus* (Poir.) St. John, Rh. **19**: 167. 1917.

Meadows, waste ground, borders of ponds, sloughs, wet ground, and wet depressions in rocky glades. Circumneutral to calciphile. General. Typical *A. geniculatus* does not reach Mo. This species is much commoner than the next following.

Alopecurus aequalis Sobol. See Rh. **27**: 196. 1925. Floating Fox-tail Grass.

Alopecurus geniculatus var. *aristulatus* (Michx.) Torr. (G).

Alopecurus aristulatus Michx. (B & B).

Swampy ground, borders of ponds and sloughs, and wet open ground. Circumneutral. General.

PHLEUM PRATENSE L. Timothy.

Meadows, roadsides, and waste ground. Circumneutral. General.

Muhlenbergia cuspidata (Torr.) Rydb. See Rh. **18**: 233. 1916.

Sporobolus brevifolius (Nutt.) Scribn., in part (G).

Dry banks, rocky bluffs, and loess hills. Circumneutral to calciphile. Western

and southern Mo.: Crawford, Phelps, Pulaski, Miller, Camden, Atchison, Holt, Buchanan, Jackson, Henry, and McDonald counties.

Muhlenbergia asperifolia (Nees & Meyen) Parodi. See Hitchcock, Man. Grasses U. S. Misc. Publ. U. S. Dept. Agr. 200: 366. 1935. Scratch Grass.

Sporobolus asperifolius (Nees & Meyen) Thurber (B & B).

Moist sandy ground. Oxylophile. Western Mo.: Holt and Jackson counties.

Muhlenbergia sobolifera (Muhl.) Trin.

Rocky woods, shaded slopes, limestone bluffs, and prairies. Calciphile to circumneutral. General.

Muhlenbergia tenuiflora (Willd.) BSP.

Open rocky woods, glades, dry open soils, and prairies. Oxylophile to circumneutral. General.

Muhlenbergia racemosa (Michx.) BSP.

Moist prairies, alluvial banks, meadows, and open woods. Circumneutral. General.

Muhlenbergia mexicana (L.) Trin. Satin Grass.

Rocky banks and moist woods. Circumneutral. General.

Muhlenbergia mexicana f. **commutata** (Scribn.) Wiegand, Rh. **26**: 1. 1924.

In similar situations to the typical form. Local: Lincoln Co.

Muhlenbergia glabriflora Scribn.

Moist open ground. Circumneutral. Local: St. Louis Co.

Muhlenbergia sylvatica Torr. See Rh. **32**: 118. 1930.

Muhlenbergia umbrosa Scribn.

Moist rocky woods and slopes along streams. Circumneutral. General.

Muhlenbergia sylvatica f. **attenuata** (Scribn.) Palmer & Steyermark, comb. nov.

Muhlenbergia umbrosa f. *attenuata* (Scribn.) Deam, Publ. Indiana Dept. Conserv. 82: 171. 1929.

Occasionally found in similar situations to the preceding. Scattered: Gentry, St. Louis, and Greene counties.

Muhlenbergia foliosa Trin.

Thickets and open woods, and moist ground. Circumneutral. Western Mo.: Jackson and Jasper counties.

Muhlenbergia Schreberi J. F. Gmel. Drop-seed Grass, Nimble Will.

Moist open and waste ground; often about dwellings. Circumneutral. General.

Muhlenbergia curtisetosa (Scribn.) Bush.

Muhlenbergia Schreberi var. *curtisetosa* Scribn.

Rocky ground. Circumneutral. Southwestern Mo.: Barry Co.

Muhlenbergia brachyphylla Bush, Am. Midl. Nat. **6**: 41. 1919.

Prairie banks and low moist woods. Circumneutral. Southwestern Mo.: Barton and Jasper counties.

Muhlenbergia capillaris (Lam.) Trin. Hair Grass.

Dry open ground and cherty woods. Oxylophile. Southern Mo.: Shannon, Ozark, Taney, Henry, Barry, Greene, Jasper, Newton, and McDonald counties.

Muhlenbergia expansa (DC.) Trin. See Hitchcock, Man. Grasses U. S. Misc. Publ. U. S. Dept. Agr. 200: 386. 1935.

Muhlenbergia trichopodes (Ell.) Chapm.

Dry rocky ground. Circumneutral. Southwestern Mo., local: McDonald Co.

SPOROBOLUS POIRETII Roem. & Schult. See Bartonia 14: 32. 1932, and Am. Jour. Bot. **21**: 136. 1934. Smut Grass.

Sporobolus Berteroanus (Trin.) Hitchc. & Chase.

Sporobolus indicus of auth., not R. Br. (G).

Introduced in cotton fields. Circumneutral. Southeastern Mo.: Dunklin Co.

Sporobolus vaginiflorus (Torr.) Wood.

Prairies, fields, and waste places, sterile soils. Oxylophile. General.

Sporobolus neglectus Nash.

Rocky open woods, glades, fields, and waste places. Oxylophile to circumneutral. General but scattered: St. Louis, Jefferson, Shannon, Montgomery, Boone, Macon, Jackson, Henry, Jasper, Barry, Stone, and Ozark counties.

Sporobolus ozarkanus Fernald, Rh. **25**: 109. 1933.

Chert glades. Oxylophile. Southwestern Mo., local: Jasper Co.

Sporobolus asper (Michx.) Kunth. Bush Grass.

Dry prairies, rocky open woods and glades, and waste ground. Oxylophile to circumneutral. General but scattered: St. Louis, Franklin, Macon, Sullivan, Boone, Cooper, Henry, Caldwell, Jackson, Jasper, and Newton counties.

Sporobolus asper var. **pilosus** (Vasey) Hitchc. Proc. Biol. Soc. Wash. **41**: 161. 1928.

Sporobolus pilosus Vasey (B & B).

Rocky open ground. Oxylophile. Southern Mo.: Jefferson, Washington, Iron, Jasper, and Barry counties.

Sporobolus asper var. **Hookeri** (Trin.) Vasey. See Hitchcock, Man. Grasses U. S. Misc. Publ. U. S. Dept. Agr. 200: 398, 958. 1935.

Sporobolus Drummondii (Trin.) Vasey (B & B).

Sporobolus attenuatus Nash (B & B).

Rocky open woods, glades, and prairies. Oxylophile to circumneutral. Central, western, and southern Mo.: St. Louis, Phelps, Jackson, Caldwell, and Jasper counties.

Sporobolus clandestinus (Spreng.) Hitchc.

Sporobolus canovirens Nash (G), (B & B).

Rocky open woods, glades, open ground, and prairies. Oxylophile. East-central and southern Mo.: Lincoln, Boone, Montgomery, Warren, St. Louis, Jefferson, Ste. Genevieve, St. Francois, Washington, Crawford, Iron, Scott, Dunklin, Phelps, Dent, Shannon, Ozark, Taney, Barry, Jasper, Newton, and McDonald counties.

Sporobolus heterolepis Gray. Dropseed Grass.

Prairies, glades, and rocky cliffs. Calciphile to circumneutral. General, though apparently absent from much of the southwestern part: Clark, Lewis, Marion, Ralls, Pike, St. Louis, Jefferson, Washington, St. Francois, Madison, Iron, Reynolds, Carter, Shannon, Texas, Dent, Phelps, Maries, Pulaski, Callaway, Shelby, Schuyler, Randolph, Macon, Linn, Sullivan, Worth, Daviess, Dekalb, Clinton, Caldwell, Jackson, Johnson, Henry, and Taney counties.

Sporobolus argutus (Nees) Kunth.
Dry open ground. Introduced in Jackson Co.

Sporobolus cryptandrus (Torr.) Gray. Sand Dropseed.
Dry or moist open ground, usually in sandy soil, and loess mounds, also introduced along railroads. Oxylophile. Central and western Mo., mostly along the larger rivers: St. Louis, Jefferson, Montgomery, Boone, Moniteau, Atchison, Holt, Andrew, Buchanan, Clay, and Jackson counties.

Sporobolus airoides Torr. Alkali Sacaton.
Loess hills. Calciphile. Northwestern Mo.: Atchison Co., and also introduced in Jackson Co.

Heleochloa schoenoides (L.) Host.
Introduced in meadows. Local: St. Louis Co.

Brachyelytrum erectum (Schreb.) Beauv.
Rocky woods and bluffs. Circumneutral to calciphile. General, but commonest in southern Mo.

Oryzopsis racemosa (Sm.) Ricker. Black-seeded Mountain Rice.
Woods. Circumneutral. Eastern Mo., local: Clark and Shannon counties.

Stipa spartea Trin. Porcupine Grass.
Dry rocky prairies. Oxylophile. Northern and western Mo., uncommon: Macon, Adair, Schuyler, Mercer, Daviess, Dekalb, Nodaway, Jackson, Barton, and Jasper counties. Also reported from Greene Co.

Aristida basiramea Engelm. Triple-awned Grass.
Dry open ground. Oxylophile. Central Mo., local: Montgomery and Jackson counties.

Aristida dichotoma Michx. Poverty Grass.
Dry prairies, glades, open upland woods, and waste ground. Oxylophile. General and common.

Aristida Curtissii (Gray) Nash. See Contr. U. S. Nat. Herb. **22**: 535–536. 1924.
Aristida dichotoma var. *Curtissii* Gray (G).
In similar situations to the preceding. Oxylophile. Central and southern Mo.: St. Louis, Jefferson, Madison, Crawford, Montgomery, Polk, Barry, and Newton counties.

Aristida oligantha Michx. Triple-awned Grass.
Dry open ground, glades, sterile fields, and waste ground. Oxylophile. General.

Aristida ramosissima Engelm. Branching Poverty Grass.
Dry prairies, glades, and sterile soils. Oxylophile. Central and southern Mo.: St. Louis, St. Francois, Dunklin, Butler, and Greene counties.

Aristida longespica Poir. See Contr. U. S. Nat. Herb. **22**: 538–539. 1924.
Aristida gracilis Ell. (G), (B & B).
Rocky prairies, glades, sterile fields, and waste ground. Oxylophile. Eastern, central, and southern Mo.: Marion, St. Louis, Jefferson, St. Francois, Ste. Genevieve, Dunklin, Dent, Boone, Cooper, Jackson, Greene, Barry, Jasper, and McDonald counties.

Aristida adscensionis L. See Contr. U. S. Nat. Herb. **22**: 541–545. 1924.

Aristida fasciculata Torr. (B & B).

Aristida bromoides HBK.

Upland prairies and sterile open ground. Oxylophile. Central and southern Mo.: Maries, Madison, Jackson, and Jasper counties.

Aristida intermedia Scribn. & Ball.

Dry rocky woods, glades, and sterile prairies. Oxylophile. Central and southern Mo.: St. Louis, Washington, Iron, Jackson, and Jasper counties.

Aristida lanosa Muhl.

Sandy open ground. Oxylophile. Southeastern Mo., local: Stoddard Co.

Aristida purpurascens Poir.

Rocky open woods, glades, and open ground. Oxylophile. Central and southern Mo.: Lincoln, St. Louis, Jefferson, Ste. Genevieve, Madison, Scott, Stoddard, Dunklin, Crawford, Dent, Shannon, Montgomery, Polk, Henry, Ozark, Taney, Barry, Jasper, Newton, and McDonald counties.

Leptochloa filiformis (Lam.) Beauv. Red Sprangle Top.

Leptochloa attenuata (Nutt.) Steud. (B & B).

Leptochloa mucronata Kunth.

Fields, low cultivated ground, and alluvial ground along the larger rivers. Circumneutral. Central and southern Mo.: St. Charles, St. Louis, Jefferson, Perry, Mississippi, Dunklin, Butler, Ripley, Crawford, Carroll, Jackson, Greene, Ozark, Taney, Vernon, Barton, Jasper, and Newton counties.

Diplachne acuminata Nash.

Wet open ground along the Missouri River, and wet soil about saline springs. Calciphile to circumneutral. Western Mo.: Atchison, Holt, Jackson, Carroll, Saline, Randolph, Howard, Cooper, and Jackson counties.

Diplachne fascicularis (Lam.) Beauv.

Leptochloa fascicularis (Lam.) Gray (G).

Wet open ground along the larger streams, saline springs, and depressions in rocky glades. Calciphile to circumneutral. Central and southern Mo.: St. Louis, Jefferson, New Madrid, Ripley, Randolph, Saline, Carroll, Clinton, Holt, Buchanan, Clay, Jackson, Greene, Jasper, and Newton counties.

ELEUSINE INDICA (L.) Gaertn. Goose Grass, Yard Grass.

Waste and cultivated ground. Indifferent. General and common.

CYNODON DACTYLON (L.) Pers. Bermuda Grass.

Open, waste, sandy, and cultivated ground. Oxylophile to circumneutral. Central and southern Mo.: St. Charles, St. Louis, Jefferson, Mississippi, Dunklin, Butler, Boone, Jackson, Vernon, and Jasper counties.

Schedonnardus paniculatus (Nutt.) Trel. Tumble Grass.

Dry open woods, prairies, glades, and waste ground. Oxylophile to circumneutral. Middle and western Mo.: Boone, Andrew, Wright, Greene, Jackson, Jasper, and Newton counties.

Beckmannia Syzigachne (Steud.) Fernald, Rh. **30**: 27. 1928. American Slough Grass.

Beckmannia erucaeformis of Am. auth. in part, not Host (G), (B & B).

Wet open ground. Introduced in Jackson Co.

Spartina pectinata Link, See Rh. **35**: 258–260. 1933. Slough Grass.

Spartina Michauxiana Hitchc. in part (G).

Wet meadows, sloughs, and margins of ponds. Circumneutral to calciphile. General.

Spartina pectinata var. **Suttiei** (Farwell) Fernald, Rh. **35**: 260. 1933.

Commonly found with the typical form but more frequent.

Gymnopogon ambiguus (Michx.) BSP.

Rocky open woods, sandy open places, and glades. Oxylophile. Southern and east-central Mo.: St. Charles, Jefferson, Scott, Stoddard, Shannon, Dent, Crawford, Jasper, Newton, and McDonald counties.

Chloris verticillata Nutt. Windmill Grass.

Upland prairies and waste ground; introduced from farther west. Middle and western Mo.: Boone, Jackson, and Jasper counties.

Chloris virgata Sw.

Chloris elegans HBK. (G), (B & B).

Introduced in Jackson Co.

Bouteloua curtipendula (Michx.) Torr.

Rocky open woods and glades. Circumneutral to calciphile. General.

Bouteloua gracilis (HBK.) Lag. See Contr. U. S. Nat. Herb. **14**[3]: 375. 1912. Mesquite Grass, Blue Grama.

Bouteloua oligostachya (Nutt.) Torr. (G), (B & B).

Upland prairies and loess hills. Circumneutral to calciphile. Western Mo.: Atchison, Holt, and Jackson counties.

Bouteloua hirsuta Lag. Hairy Mesquite Grass, Hairy Grama.

Loess hills. Calciphile. Northwestern Mo.: Atchison and Holt counties.

Buchloë dactyloides (Nutt.) Engelm. Buffalo Grass.

Loess hills. Calciphile. Northwestern Mo.: Atchison and Holt counties, and also introduced in Jackson Co.

ANTHOXANTHUM ODORATUM L. Sweet Vernal Grass.

Introduced along railroad: Jackson Co., and also reported from St. Louis Co.

PHALARIS CANARIENSIS L. Canary Grass.

Waste ground, and along railroads and roadsides. Indifferent. Scattered: St. Louis, Madison, Jackson, and Jasper counties.

Phalaris arundinacea L. Reed Canary Grass.

Wet meadows and ditches along roadsides. Circumneutral. Northern and western Mo., uncommon: Macon, Holt, Andrew, Clay, and Jackson counties.

Phalaris caroliniana Walt. Canary Grass.

Moist open ground. Circumneutral. Central and southern Mo., scattered and uncommon: Scott, Dunklin, Butler, Jackson, Johnson, Greene, and Jasper counties.

Leersia lenticularis Michx. Catch-fly Grass.

Wooded swamps and borders of bayous and streams. Circumneutral. General, but commonest in southern Mo.: Lincoln, St. Louis, Jefferson, Mississippi, New Madrid, Dunklin, Butler, Clinton, and Jasper counties.

Leersia oryzoides (L.) Sw. Rice Cut Grass.

Swamps and wet meadows. Circumneutral. General.

Leersia virginica Willd. Cut Grass, White Grass.

Swamps, wet woods, and low meadows. Circumneutral. General.

Zizania aquatica L. var. **interior** Fassett, Rh. **26**: 158. 1924. Water Rice, Indian Rice.

Swamps and borders of ponds and streams. Circumneutral. Scattered and uncommon: St. Charles, New Madrid, Dunklin, Butler, Clay, Jackson, Greene, and Newton counties.

Zizaniopsis miliacea (Michx.) Döll. & Asch.

Swampy ground and borders of ditches. Circumneutral. Southeastern Mo.: Pemiscot and Dunklin counties.

DIGITARIA SANGUINALIS (L.) Scop. Crab Grass, Finger Grass.

Waste and cultivated ground. Often a troublesome weed. Indifferent. General.

DIGITARIA SANGUINALIS var. MARGINATA (Link) Fernald, Rh. **22**: 103. 1920.

Syntherisma marginata (Link) Nash (B & B).

Occasionally found with the typical form. Scattered: Dunklin Co.

DIGITARIA ISCHAEMUM Schreb. See Rh. **18**: 231. 1916. Small Crab Grass.

Digitaria humifusa Pers. (G).

Syntherisma linearis (Krock.) Nash (B & B).

Waste and cultivated ground. Indifferent. General.

Digitaria filiformis (L.) Koeler. Slender Finger Grass.

Prairies, glades, and sandy fields. Oxylophile to circumneutral. Central and southern Mo.: Boone, Gasconade, Dent, Maries, Madison, Jackson, Jasper, Newton, McDonald, and Stone counties.

Digitaria filiformis var. **villosa** (Walt.) Fernald, Rh. **36**: 19–20. 1934.

Digitaria villosa (Walt.) Ell. (G).

Prairies and glades. Oxylophile. Southern and east-central Mo.: St. Louis, St. Francois, Iron, Dunklin, Jasper, and McDonald counties.

Leptoloma cognatum (Schultes) Chase. Fall Witch Grass.

Prairies, glades, and waste ground. Oxylophile. General.

Eriochloa contracta Hitchc. Dotted Millet, Prairie Cup Grass.

Eriochloa punctata of auth., not Hamilton (G), (B & B).

Introduced in cultivated and waste ground. Uncommon. Circumneutral. Boone and Jackson counties.

Paspalum repens Bergius. See Contr. U. S. Nat. Herb. **28**: 31–32. 1929.

Paspalum mucronatum Muhl. (G), (B & B).

Wet alluvial ground along streams and margins of ponds and lakes. Circumneutral. Eastern, central, and southern Mo.: Marion, St. Louis, Jefferson, New Madrid, Dunklin, Butler, Howell, Chariton, Jackson, Johnson, Vernon, Jasper, and Barry counties.

Paspalum dissectum L.

Muddy banks of streams and ditches. Circumneutral to oxylophile. Southern Mo., scattered: Dunklin and Jasper counties.

Paspalum ciliatifolium Michx.

Prairies and borders of woods. Oxylophile to circumneutral. Southwestern Mo.: Jasper Co.

Paspalum ciliatifolium var. **stramineum** (Nash) Fernald, Rh. **36**: 20. 1934.

Paspalum stramineum Nash (G), (B & B).

Paspalum Bushii Nash (G).

Prairies and open woods. Oxylophile. General: Putnam, Jefferson, Dent, Pemiscot, Dunklin, Clay, Jackson, and Polk counties.

Paspalum ciliatifolium var. **Muhlenbergii** (Nash) Fernald, Rh. **36**: 20. 1934.

Paspalum Muhlenbergii Nash (G), (B & B).

Paspalum pubescens Muhl. (G), (B & B).

Prairies, rocky banks, and open woods. Oxylophile to circumneutral. General: Putnam, Warren, St. Louis, Jefferson, Franklin, Ste. Genevieve, St. Francois, Mississippi, Pemiscot, Dunklin, Oregon, Pulaski, Boone, Saline, Jackson, Barton, Jasper, and Greene counties.

Paspalum floridanum Michx.

Moist meadows and prairie swales. Oxylophile to circumneutral. Southern Mo.: Mississippi, Barton, and Jasper counties.

Paspalum pubiflorum Rupr. var. **glabrum** Vasey. See Rh. **36**: 22. 1934.

Paspalum laeviglume Scribn. (G), (B & B).

Moist open ground, meadows, and prairie swales; sometimes a weed in waste ground. Circumneutral. Southern Mo.: Jefferson, Ste. Genevieve, Dunklin, Butler, Taney, Jasper, and McDonald counties.

Paspalum laeve Michx. var. **circulare** (Nash) Stone. See Rh. **36**: 22. 1934.

Paspalum circulare Nash (G), (B & B).

Prairies, fields, and moist open ground. Circumneutral to oxylophile. Central and southern Mo.: Lincoln, St. Louis, Jefferson, Scott, Mississippi, New Madrid, Dunklin, Butler, Randolph, Boone, Callaway, Dent, Shannon, Oregon, Texas, Howell, Wright, Greene, Jackson, Barton, Jasper, and McDonald counties.

Paspalum laeve var. **pilosum** Scribn. See Rh. **36**: 22. 1934.

Paspalum plenipilum Nash (G), (B & B).

Paspalum praelongum Nash.

Low ground, and borders of lakes and bayous. Circumneutral. Southern Mo., scattered: New Madrid and Wright counties.

Panicum depauperatum Muhl. See Rh. **23**: 194. 1921.

Prairies, glades, open sterile woods, and waste ground. Oxylophile. General, but commonest in central and southern Mo.: Schuyler, Lincoln, St. Louis, Jefferson, St. Francois, Ste. Genevieve, Bollinger, Wayne, Shannon, Ripley, Greene, Wright, Webster, Ozark, Stone, Jasper, Newton, and McDonald counties.

Panicum perlongum Nash.

Rocky prairies, glades, and open woods, chiefly in chert, gravel, or sand. Oxylophile. General.

Panicum linearifolium Scribn.

Prairies, glades, and rocky open woods. Oxylophile. General.

Panicum linearifolium var. **Werneri** (Scribn.) Fernald, Rh. **23**: 194. 1921.

Panicum Werneri Scribn. (G), (B & B).

Rocky prairies, glades, and open woods. Oxylophile. Southern Mo.: Ste. Genevieve, St. Francois, Iron, Ozark, Douglas, Webster, Christian, Taney, and Jasper counties.

Panicum xalapense HBK.

Low woods and wet rocky or sandy banks. Oxylophile to circumneutral. Central and southern Mo.: Boone, St. Louis, Franklin, Jefferson, St. Francois, Ste. Genevieve, Bollinger, Iron, Wayne, Dunklin, Ripley, Texas, Douglas, Taney, Stone, and McDonald counties.

Panicum Bicknellii Nash. See Contr. U. S. Nat. Herb. **15**: 177. 1910.

Panicum Bushii Nash (B & B).

Dry rocky woods and prairies. Oxylophile to circumneutral. Southern Mo.: Dent, Wayne, Bates, Christian, Barry, and McDonald counties.

Panicum microcarpon Muhl.

Wet woods and low open ground. Oxylophile to circumneutral. Southern Mo.: St. Francois, Madison, Jefferson, Ste. Genevieve, Perry, Bollinger, Dunklin, Pemiscot, Butler, Ripley, Barry, and McDonald counties.

Panicum nitidum Lam.

Low wet ground. Circumneutral. Southeastern Mo.: Carter Co. (according to Hitchcock & Chase).

Panicum annulum Ashe.

Dry woods. Oxylophile to circumneutral. Southeastern Mo.: Carter Co.

Panicum dichotomum L.

Rocky open woods. Oxylophile. Southern and east-central Mo.: Warren, St. Louis, Jefferson, St. Francois, Madison, Bollinger, Iron, Dunklin, Wayne, Ripley, Oregon, Crawford, Dent, Shannon, Texas, Miller, Morgan, Laclede, Hickory, Douglas, Taney, Greene, Barry, and Jasper counties.

Panicum barbulatum Michx.

Rocky open woods and glades. Oxylophile. Southern Mo.: Jefferson, Ste. Genevieve, Perry, Bollinger, Wayne, Iron, Dunklin, Ripley, Carter, Shannon, Oregon, Gasconade, Texas, Howell, Christian, Taney, Barry, and McDonald counties.

Panicum spretum Schult.

Alluvial woods, prairies, and sandy open ground. Circumneutral. Southern Mo.: New Madrid and Jasper counties.

Panicum lanuginosum Ell. var. **Lindheimeri** (Nash) Fernald, Rh. **36**: 77. 1934.

Panicum Lindheimeri Nash (G), (B & B).

Sandy or sterile woods and prairies. Oxylophile to circumneutral. General.

Panicum lanuginosum var. **septentrionale** Fernald, Rh. **36**: 77. 1934.

Panicum tennesseense Ashe, in part (G), (B & B).

Panicum Lindheimeri var. *septentrionale* (Fern.) Fernald, Rh. **23**: 227. 1922.

Dry open woods and barrens. Oxylophile. Central and southern Mo.: Boone, Miller, Madison, Shannon, and Taney counties.

Panicum lanuginosum var. **fasciculatum** (Torr.) Fernald, Rh. **36**: 77. 1934.

Panicum huachucae Ashe (G), (B & B).

Panicum tennesseense Ashe, in part (G), (B & B).

Panicum huachucae var. *silvicola* Hitchc. & Chase (G).

Panicum Lindheimeri var. *fasciculatum* (Torr.) Fernald, Rh. **23**: 228. 1922.

Dry open woods. Oxylophile to circumneutral. General.

Panicum lanuginosum var. **implicatum** (Scribn.) Fernald, Rh. **36**: 77. 1934.

Panicum implicatum Scribn. (G), (B & B).

Panicum Lindheimeri var. *implicatum* (Scribn.) Fernald, Rh. **23**: 228. 1922.

Wet woods and prairie swales. Oxylophile to circumneutral. Eastern, central, and southern Mo.: Schuyler, Knox, Boone, St. Louis, Jefferson, Ste. Genevieve, Dent, Shannon, Hickory, Polk, and Jasper counties.

Panicum subvillosum Ashe.

Dry rocky woods. Oxylophile. Southwestern Mo.: Jasper and Newton counties.

Panicum praecocius Hitchc. & Chase.

Dry open woods, prairies, glades, and thickets. Oxylophile to circumneutral. General.

Panicum villosissimum Nash.

Dry open woods and thickets, usually in cherty, sandy, or granitic soils. Oxylophile. East-central and southern Mo.: Montgomery, Warren, St. Louis, Jefferson, Dunklin, Ripley, Carter, Crawford, Shannon, Texas, Christian, Barry, and McDonald counties.

Panicum sphaerocarpon Ell.

Dry open woods, glades and prairies, and alluvial or moist ground along streams, and thickets, usually in rocky or sandy ground. Oxylophile. Central and southern Mo.: Lincoln, St. Louis, Jefferson, Franklin, Washington, Ste. Genevieve, Perry, Bollinger, St. Francois, Madison, Iron, Dent, Shannon, Carter, Phelps, Texas, Morgan, Douglas, Ozark, Taney, Boone, Hickory, Polk, St. Clair, Cedar, Jackson, Jasper, Newton, McDonald, and Barry counties.

Panicum sphaerocarpon var. **inflatum** (Scribn. & Smith) Hitchc. Rh. **13**: 68. 1911.

Moist sandy open ground. Oxylophile. Southeastern Mo.: Shannon Co.

Panicum polyanthes Schultes.

Low wet woods, banks of streams, and prairie swales. Oxylophile to circumneutral. Eastern and middle Mo.: Lincoln, St. Charles, St. Louis, Franklin, Ste. Genevieve, Perry, Bollinger, Iron, Mississippi, Dunklin, Butler, Ripley, Crawford, Boone, and Phelps counties.

Panicum malacophyllum Nash.

Open sandy woods. Oxylophile. Local: Johnson and Jasper counties.

Panicum oligosanthes Schultes var. **Scribnerianum** (Nash) Fernald, Rh. **36**: 80. 1934.

Panicum Scribnerianum Nash (G), (B & B).

Dry open woods, barrens, rocky banks, and dry prairies. Oxylophile. General.

Panicum oligosanthes var. **Helleri** (Nash) Fernald, Rh. **36**: 80. 1934.

Panicum Helleri Nash (B & B).

Rocky open woods and prairies. Oxylophile. Western Mo.: Jackson, Jasper, Newton, and McDonald counties.

Panicum Ravenelii Scribn. & Merr.

Dry ground. Circumneutral to oxylophile. Southern Mo.: Ste. Genevieve, Bollinger, Dent, Shannon, Ripley, Texas, Polk, Cedar, Taney, Barry, and McDonald counties.

Panicum Leibergii (Vasey) Scribn.

Prairies and open woods. Circumneutral to oxylophile. Central and southern Mo.: St. Louis, Phelps, Shannon, and Jackson counties.

Panicum scoparium Lam.

Prairie swales and banks, chiefly on wet sands. Oxylophile. Southern Mo.: Mississippi, Howell, Henry, Vernon, Barton, and Jasper counties.

Panicum commutatum Schultes.

Open or alluvial rich woods and thickets. Circumneutral. Southern Mo.: Bollinger, Dunklin, Pemiscot, Butler, Ripley, Ste. Genevieve, Carter, Shannon, Taney, Stone, and McDonald counties.

Panicum commutatum var. **Ashei** (Pearson) Fernald, Rh. **36**: 83. 1934.

Panicum Ashei Pearson (G), (B & B).

Dry open woods and rocky banks. Circumneutral to oxylophile. Southern Mo.: Ripley, Shannon, Texas, Douglas, Taney, Stone, Christian, and McDonald counties.

Panicum clandestinum L.

Open upland woods and thickets. Circumneutral to oxylophile. General.

Panicum latifolium L.

Rich or rocky woods and thickets. Circumneutral. General.

Panicum Boscii Poir.

Panicum Porterianum Nash.

Dry open woods and thickets. Circumneutral to oxylophile. General.

Panicum Boscii var. **molle** (Vasey) Hitchc. & Chase. See Contr. U. S. Nat. Herb. **15**: 319–320. 1910.

Panicum pubifolium Nash.

In similar situations to the typical form. Southern Mo.: Shannon, Wright, Taney, Barry, and McDonald counties.

Panicum dichotomiflorum Michx.

Cultivated and waste ground, sometimes on glades and in alluvial soils, often a weed on dumps and ballast. Indifferent. General.

Panicum flexile (Gattinger) Scribn.

Glades and rocky open ground. Oxylophile to circumneutral. Central and southern Mo. and locally north in Gentry Co.: St. Louis, Jefferson, Franklin, Ste. Genevieve, Dunklin, Crawford, Dent, Reynolds, Shannon, Maries, Pulaski, Camden, Boone, Randolph, Jackson, Polk, Greene, Ozark, Taney, Barry, Jasper, McDonald, and Gentry counties.

Panicum Gattingeri Nash.

Dry rocky ground and barrens, and sometimes in wet ground along streams and sloughs, or as a weed in cultivated ground. Oxylophile to circumneutral, Central and southern Mo.: St. Louis, Jefferson, St. Francois, Wayne, Shannon, Boone, Jackson, Greene, Taney, Jasper, and McDonald counties.

Panicum philadelphicum Bernh.

Glades and rocky open ground. Circumneutral. Southern and east-central Mo.: St. Louis, Jefferson, St. Francois, Dent, Shannon, Wayne, Maries, Texas, Howell, Henry, Jasper, and Newton counties.

Panicum capillare L. Witch Grass.

Open cultivated, waste and alluvial ground. Indifferent. General and common.

Panicum capillare var. **occidentale** Rydb. See Rh. **21**: 111. 1919.

Occasionally found with the typical form: Putnam, Macon, Marion, Ralls, Pike, St. Louis, Cole, and Jackson counties.

PANICUM MILIACEUM L. Broom-corn Millet.

Sparingly escaped in cultivated and waste ground. Western Mo.: Jackson Co.

Panicum virgatum L. Switch Grass.

Prairie swales, wet open woods, moist glades and ledges, and gravel bars along streams. Indifferent. General.

Panicum agrostoides Spreng.

Wet prairies, open woods, and borders of sloughs and ponds. Circumneutral. Central and southern Mo.: Lincoln, St. Louis, St. Charles, Franklin, Jefferson, Stoddard, New Madrid, Dunklin, Butler, Wayne, Oregon, Shannon, Gasconade, Howell, Jackson, Vernon, Greene, and Jasper counties.

Panicum stipitatum Nash.

Panicum elongatum Pursh, not Salisb.

Wet banks. Circumneutral. Southeastern Mo.: Wayne, Shannon, and Dunklin counties.

Panicum anceps Michx.

Moist sandy ground, wet prairies, borders of streams, and low open woods. Oxylophile. Central and southern Mo.: St. Louis, Jefferson, Franklin, St. Francois, Iron, Perry, Cape Girardeau, Scott, Dunklin, Butler, Ripley, Crawford, Shannon, Pulaski, Barton, Greene, and Jasper counties.

Panicum hians Ell. See Rh. **13**: 67. 1911.

Steinchisma hians (Ell.) Nash (G), (B & B).

Swamps and wet woods. Oxylophile. Southeastern Mo.: Dunklin, Butler, and Ripley counties.

Panicum obtusum HBK. Vine Mesquite.

Introduced in sandy soil along the Missouri River. Western Mo.: Jackson Co.

ECHINOCHLOA CRUS-GALLI (L.) Beauv. See Rh. **23**: 58. 1921. Barnyard Grass.

Moist open and cultivated ground. Circumneutral. General but not common: Clark, Scott, and Jackson counties. This has often been confused with *Echinochloa pungens* and varieties.

ECHINOCHLOA CRUS-GALLI f. LONGISETA (Trin.) Farwell.

Alluvial and waste ground. Circumneutral. Scattered in central Mo.: St. Charles, St. Louis, Miller, and Jackson counties.

Echinochloa pungens (Poir.) Rydb. See Rh. **37**: 137. 1935. Barnyard Grass.

Echinochloa muricata (Michx.) Fernald.

Waste, cultivated, and alluvial ground, borders of streams, ponds, and sloughs, and thickets. Indifferent. General and common.

Echinochloa pungens var. **occidentalis** (Wiegand) Fernald & Griscom, Rh. **37**: 137. 1935.

Echinochloa occidentalis (Wiegand) Rydb. (R).

Waste, cultivated and alluvial ground. Indifferent. General: Putnam, Schuyler, Lincoln, Marion, St. Louis, Jefferson, Saline, and Taney counties.

Echinochloa pungens var. **microstachya** (Wiegand) Fernald & Griscom, Rh. **37**: 137. 1935.

Echinochloa muricata var. *microstachya* Wiegand.

Echinochloa microstachya (Wiegand) Rydb. (R).

In similar situations to the preceding. Indifferent. Western Mo.: Jackson and Holt counties.

Echinochloa pungens var. **ludoviciana** (Wiegand) Fernald & Griscom, Rh. **37**: 137. 1935.

Echinochloa muricata var. *ludoviciana* Wiegand.

Alluvial ground. Circumneutral. Scattered in central Mo.: St. Louis, Clay, and Jackson counties.

Echinochloa colonum (L.) Link. Jungle Rice.

Moist ground. Circumneutral. Southeastern Mo., local: Pemiscot Co.

Setaria lutescens (Weigel) Hubbard, Rh. **18**: 232. 1916. Yellow Foxtail Grass.

Setaria glauca (L.) Beauv. (G), (B & B).

Waste and cultivated ground. Indifferent. General and common.

Setaria geniculata Beauv. Prairie Foxtail Grass.

Setaria imberbis R. & S. (G), (B & B).

Prairies, usually in sandy or cherty soil. Oxylophile. General but scattered: Putnam, Randolph, Linn, St. Louis, Mississippi, Dunklin, Shannon, Phelps, Hickory, Vernon, Barton, and Jasper counties.

Setaria verticillata (L.) Beauv. Foxtail Grass.

Waste and cultivated ground. Circumneutral. General but less common than the following.

Setaria viridis (L.) Beauv. Green Foxtail Grass.

Waste and cultivated ground. Indifferent. General and common.

Setaria italica (L.) Beauv. Italian Millet.

Escaped from cultivation, in waste ground and along railroads and roadsides. Scattered.

Setaria italica var. germanica (Mill.) Richter. Hungarian Millet.

Occasionally escaped from cultivation, in waste ground and along railways and roadsides. Scattered.

Cenchrus pauciflorus Benth. See Contr. U. S. Nat. Herb. **22**[1]: 67. 1920. Bur Grass, Sand-burs.

Cenchrus carolinianus of some auth., not Walt. (G), (B & B).

Waste ground and along roadsides and railways. Oxylophile. General but scattered.

Erianthus strictus Baldw. Beard Grass.

Swampy ground and wet open woods. Circumneutral. Southeastern Mo.: Dunklin Co.

Erianthus alopecuroides (L.) Ell. See Am. Jour. Bot. **21**: 139. 1934. Woolly Beard Grass.

Erianthus divaricatus (L.) Hitchc. (G), (B & B).

Moist rocky open woods and thickets. Oxylophile. Southern Mo.: Iron, Shannon, Carter, Dunklin, Ozark, Taney, Christian, Stone, and Barry counties.

ARTHRAXON HISPIDUS (Thunb.) Merr. var. CRYPTATHERUS (Hack.) Honda.
Moist grassy banks. Circumneutral. Introduced in St. Louis Co.

Andropogon scoparius Michx. var. **genuinus** Fernald & Griscom, Rh. **37**: 144. 1935. Blue-stem, Prairie Beard Grass.
Andropogon scoparius var. *villosissimus* Kearney.
Prairies, glades, open and waste ground. Oxylophile. General.

Andropogon scoparius var. **frequens** Hubbard, Rh. **19**: 103. 1917.
Similar situations to the preceding. Oxylophile. General.

Andropogon scoparius var. **divergens** Hack. See Rh. **37**: 144. 1935.
Prairies, glades, and sandy open ground. Oxylophile. Eastern Mo.: Lewis, St. Louis, and Scott counties.

Andropogon virginicus L. var. **genuinus** Fernald & Griscom, Rh. **37**: 142. 1935. Old Field Beard Grass, Broom Sedge.
Prairies, glades, old fields, and waste ground. Oxylophile. Central and southern Mo. south and east of a line drawn from Lincoln, Boone, and Cooper counties to Henry and Vernon counties.

Andropogon virginicus var. **tetrastachyus** (Ell.) Hack. See Rh. **37**: 142. 1935.
Sandy open and waste ground. Oxylophile. Southeastern Mo.: Madison and Mississippi counties.

Andropogon provincialis Lam. See Rh. **37**: 146. 1935. Big Blue-stem, Bluejoint Turkeyfoot.
Andropogon furcatus Muhl. (G), (B & B).
Prairies, glades, and open rocky woods. Oxylophile to circumneutral. General.

Andropogon provincialis var. **chrysocomus** (Nash) Fernald & Griscom, Rh. **37**: 147. 1935.
Andropogon chrysocomus Nash (B & B).
Prairies and waste ground. Oxylophile. Southwestern Mo.: Jackson, Stone, and Jasper counties.

Andropogon ternarius Michx. Silvery Beard Grass.
Prairies and rocky open slopes, usually in sandy or cherty soils. Oxylophile. Southern Mo.: Ste. Genevieve, Madison, Stoddard, Dunklin, Jasper, and McDonald counties.

Andropogon Elliottii Chapm.
Prairies, glades, and sandy open woods. Oxylophile. Southern Mo.: Jefferson, Madison, Shannon, and Barry counties.

Andropogon Elliottii var. **projectus** Fernald & Griscom, Rh. **37**: 139. 1935.
Similar situations to the preceding. Oxylophile. Southern Mo.: Shannon and Taney counties.

Andropogon saccharoides Sw. Beard Grass.
Andropogon Torreyanus Steud.
Amphilophis saccharoides (Sw.) Nash (B & B).
Prairies, glades, and rocky ledges. Oxylophile. Southwestern Mo.: Jasper and McDonald counties, and also adventive in Jackson Co.

SORGHUM HALEPENSE (L.) Pers. Johnson Grass.

Introduced and established in low meadows and fertile cultivated ground. Often a pernicious weed. Circumneutral. Scattered but becoming more general.

SORGHUM VULGARE L. Sorghum Cane.

Escaped in waste ground and along railways and roadsides. Circumneutral. Scattered.

Sorghastrum nutans (L.) Nash. Indian Grass.

Prairies, glades, and open rocky woods. Oxylophile. General.

Manisuris cylindrica (Michx.) Kuntze. See Hitchcock, Man. Grasses U. S. Misc. Publ. U. S. Dept. Agr. 200: 761 and 881. 1935.

Rottboellia cylindrica (Michx.) Torr., not Willd. (G).

Coelorachis cylindrica (Michx.) Nash (B & B).

Prairies and sandy open ground. Oxylophile. Scattered in southeastern and western Mo.: Mississippi and Jackson counties.

The common cultivated cereals, wheat *(Triticum aestivum)*, rye *(Secale sereale)*, and barley *(Hordeum sativum)*, as well as Indian corn *(Zea Mays)*, are frequently found growing as waifs along roads and railroads and on dumps, but as they do not self-seed nor show any sign of persisting they can scarcely be considered as additions to the flora. Sometimes *Zea Mays* is found self-seeding in rich or rocky woods where probably carried by man or lower animals, such as squirrels, and appears as a spontaneous part of the flora. Rice *(Oryza sativa)* is infrequently found as a waif in cultivated or waste ground, as an escape from cultivation.

Fam. CYPERACEAE

Cyperus flavescens L.

Low wet ground. Circumneutral. Central and southern Mo., mostly in the eastern counties: St. Louis, Jefferson, Washington, St. Francois, Iron, Madison, Dunklin, Butler, Carter, Shannon, Boone, Miller, and Webster counties.

Cyperus diandrus Torr.

Low alluvial ground along streams and sloughs. Circumneutral. General.

Cyperus compressus L. Coco Grass.

Swamps and moist cultivated ground. Circumneutral. Eastern Mo. south of the Missouri River: St. Louis, Dunklin, and Butler counties.

Cyperus rivularis Kunth.

Wet open ground. Circumneutral. General.

Cyperus Gatesii Torr.

Low woods and swamps. Circumneutral. Southeastern Mo., local: Dunklin Co.

Cyperus inflexus Muhl.

Cyperus aristatus Rottb. (G).

Wet depressions in glades, gravel, and sand bars along streams, alluvial and moist cultivated ground. Oxylophile. General, but commonest in central and southern Mo.: Marion, Ralls, Lincoln, St. Louis, Jefferson, Iron, Madison, Perry, Mississippi, Dunklin, Butler, Reynolds, Pulaski, Montgomery, Miller, Laclede, Boone, Saline, Clinton, Holt, Clay, Jackson, Henry, Cedar, Greene, Jasper, Newton, and McDonald counties.

Cyperus Schweinitzii Torr.

Low ground along streams and about ponds. Circumneutral. Scattered: St. Louis, Jefferson, and Jackson counties.

Cyperus acuminatus Torr. & Hook.

Low open ground. Circumneutral. General.

Cyperus pseudovegetus Steud.

Wet prairies and borders of streams and ponds. Circumneutral. Central and southern Mo.: Boone, New Madrid, Mississippi, Stoddard, Butler, Ripley, Jasper, Newton, and McDonald counties.

Cyperus Hallii Britton.

Missouri River bottoms. Circumneutral. Western Mo.: Jackson Co.

Cyperus esculentus L. Yellow Nut-grass.

Wet woods, sand and gravel bars along streams, prairie swales, and moist cultivated ground. Circumneutral. General.

Cyperus esculentus var. **longispicatus** Boeckl.

Occasionally found with the preceding, in similar situations.

Cyperus esculentus var. **angustispicatus** Britton.

Low wet ground. Circumneutral. Jasper Co.

Cyperus erythrorhizos Muhl.

Including *Cyperus erythrorhizos* var. *pumilus* Engelm., merely a dwarf form.

Cyperus Halei Torr.

Wet woods, low and alluvial ground along streams and lakes. Circumneutral. General but scattered: Lincoln, St. Louis, Perry, Dunklin, Butler, Putnam, Boone, Saline, Atchison, Holt, Clinton, Dekalb, Clay, Carroll, and Jackson counties.

Cyperus ferruginescens Boeckl. See Rh. **37**: 150. 1935.

Cyperus ferax of auth. in part, not Rich. (G).

Cyperus speciosus of auth. in part, not Vahl (B & B).

Low ground along streams and sloughs, especially the larger rivers. Circumneutral. General. This has been confused with *Cyperus ferax* which is known only in southeastern Mo.

Cyperus ferax Rich. See Rh. **37**: 150. 1935.

Swampy woods along St. Francis River. Circumneutral. Southeastern Mo., local: Dunklin Co. This has been confused with *Cyperus ferruginescens.*

Cyperus Engelmanni Steud.

Low alluvial ground. Circumneutral. East-central Mo., local: St. Louis Co.

Cyperus strigosus L. See Rh. **37**: 150–151. 1935.

Cyperus strigosus var. *compositus* Britton (G).

Cyperus strigosus var. *elongatus* Britton (G).

Cyperus strigosus var. *capitatus* Britton, wrongly ascribed to Boeckeler (G).

Low wet ground, along streams, ponds, and sloughs, sometimes in waste or cultivated soils. Circumneutral. General.

Cyperus strigosus var. **robustior** Britton. See Rh. **37**: 151. 1935.

Commonly found with the typical form, in similar situations.

Cyperus refractus Engelm.

Open woods or open ground, usually in dry sandy or sterile soils, also in low ground along streams, and on gravel bars. Oxylophile. Eastern and southern Mo., south of the Missouri River: St. Louis, Jefferson, Ste. Genevieve, St. Francois, Wayne, Stoddard, Butler, Reynolds, Ripley, Pulaski, Crawford, Dent, Shannon, Oregon, Howell, and Barry counties.

Cyperus lancastriensis Porter.

Prairie swales and moist rocky slopes and glades. Oxylophile to circumneutral. Southern and east-central Mo.: St. Louis, Madison, Jasper, and Newton counties.

Cyperus retrofractus (L.) Torr.

Sandy open ground, in woods or fields. Oxylophile. Southeastern Mo.: Dunklin, Ripley, and Carter counties.

Cyperus dipsaciformis Fernald.

Cyperus retrofractus of auth. in part (B & B).

Sandy open woods or fields. Oxylophile. Southeastern Mo.: Mississippi and Dunklin counties.

Cyperus ovularis (Michx.) Torr. Hedgehog Club-rush.

Sandy soil along streams, dry open woods, glades, and prairies. Oxylophile to circumneutral. Central and southern Mo. south of a line drawn from St. Louis, Montgomery, and Boone counties to Jackson Co.

Cyperus ovularis var. **robustus** Boeckl.

Occasionally found with the typical form, in similar situations.

Cyperus globulosus Aubl. See Rh. **37**: 153–154. 1935.

Cyperus echinatus (Ell.) Wood (G).

Open woods and prairies. Circumneutral. Southeastern Mo.: Dunklin Co.

Cyperus filiculmis Vahl. See Rh. **37**: 153. 1935.

Cyperus Bushii Britton (B & B), in part.

Dry open woods, prairies, and glades. Circumneutral to oxylophile. General.

Cyperus filiculmis var. **macilentus** Fernald. See Rh. **37**: 153. 1935.

Sandy open ground, glades, and banks of streams. Oxylophile. Eastern, central, and southern Mo.: Shelby, St. Charles, Jefferson, Wayne, Bollinger, Dunklin, Morgan, Hickory, Cedar, and Saline counties.

Kyllinga pumila Michx.

Wet open woods and prairies. Circumneutral. General but not common.

Dulichium arundinaceum (L.) Britton.

Borders of sloughs and ponds. Circumneutral. General but uncommon: St. Charles, St. Louis, Iron, Shannon, Howell, Boone, Jackson, Cass, and Newton counties.

Eleocharis quadrangulata (Michx.) R. & S. See Rh. **31**: 132–133. 1929.

Low muddy banks of ponds and streams. Circumneutral. Central and southern Mo., uncommon: St. Louis, Iron, Stoddard, New Madrid, Ripley, Shannon, Texas, Greene, and Newton counties.

Eleocharis obtusa (Willd.) Schultes. Spike Rush.

Muddy borders of ponds and streams. Circumneutral. General and common.

Eleocharis Engelmanni Steud.

Muddy borders of streams, sloughs, and ponds. Circumneutral. Eastern, southern, and central Mo.: Lincoln, St. Louis, Wayne, Iron, Shannon, Dent, Howell, Greene, Jasper, Barry, McDonald, and Jackson counties.

Eleocharis Engelmanni var. **robusta** Fernald.

Occasionally found with the typical form, in similar situations: Iron, Shannon, Lawrence, and Greene counties.

Eleocharis mamillata Lindb. f. See Rh. **31**: 66–67. 1929. Spike Rush.

Eleocharis macrostachya Britton (B & B).

Prairie swales and borders of streams and ponds. Circumneutral. Central and southern Mo.: Lincoln, St. Charles, St. Louis, Franklin, Washington, Lafayette, Jackson, and Jasper counties.

Eleocharis lanceolata Fernald.

Wet sandy open ground and glades. Oxylophile to circumneutral. Southern Mo.: Carter, Jasper, and Barton counties.

Eleocharis Smallii Britton. See Rh. **31**: 64–66. 1929.

Wet meadows, prairies, and sloughs. Circumneutral. General.

Eleocharis calva Torr. See Rh. **31**: 68–70. 1929. Creeping Spike Rush.

Eleocharis palustris (L.) R. & S. var. *glaucescens* of Am. auth. (G), (B & B).

Wet prairies, meadows, and sloughs. Circumneutral. General and common.

Eleocharis capitata (L.) R. Br. var. **verrucosa** Svenson, Rh. **34**: 202. 1932.

Eleocharis tenuis of auth. in part (G), (B & B).

Low woods and swampy open ground. Circumneutral. General.

Eleocharis compressa Sulliv. See Rh. **34**: 215. 1932.

Eleocharis acuminata (Muhl.) Nees (G), (B & B).

Wet prairies, depressions in glades, and borders of sloughs, ponds, and ditches. Calciphile to circumneutral. Eastern, central, and southern Mo.: Lincoln, Montgomery, St. Louis, Franklin, Jefferson, Washington, Ste. Genevieve, Iron, Texas, Shannon, Mississippi, Miller, Camden, Maries, Pulaski, Laclede, Wright, Greene, Douglas, Vernon, Jasper, Barry, and Jackson counties.

Eleocharis parvula (R. & S.) Link. See Rh. **31**: 168. 1929.

Scirpus nanus Spreng. (G), (B & B).

Marshy ground about saline springs and ponds. Middle Mo.: Cooper and Saline counties.

Eleocharis acicularis (L.) R. & S. var. **typica** Svenson, Rh. **31**: 184. 1929.

Borders of ponds and sloughs. Circumneutral. General but scattered: Putnam, Lincoln, St. Louis, Jefferson, Franklin, Dent, Carter, Shannon, Howell, Holt, Jackson, Webster, Vernon, Jasper, and Greene counties.

Eleocharis acicularis var. **gracilescens** Svenson, Rh. **31**: 191. 1929.

Springs and muddy borders of ponds and sloughs. Circumneutral. Central and southern Mo., scattered: St. Louis, Perry, Ripley, Phelps, Laclede, Texas, Ozark, Greene, and Jasper counties.

Stenophyllus capillaris (L.) Britton.

Prairie swales, glades, and barrens. Oxylophile. General but commonest in Ozark region.

Stenophyllus capillaris var. **cryptostachys** Fernald, Rh. **19**: 154. 1917.

Sandy open woods. Oxylophile. Southern Mo., local: Shannon Co.

Fimbristylis castanea (Michx.) Vahl.

Prairies and wet depressions in glades. Circumneutral to oxylophile. Central and southern Mo.: St. Louis, Shannon, Benton, Dallas, Cedar, Jackson, and Jasper counties.

Fimbristylis castanea var. **puberula** (Michx.) Britton.

Fimbristylis puberula (Michx.) Vahl (S).

High sandy prairies, upland meadows, and glades. Oxylophile to circumneutral. Central and southern Mo.: Montgomery, St. Louis, Jefferson, Washington, Franklin, Reynolds, Phelps, Maries, Madison, Iron, Douglas, Greene, Ozark, Taney, Stone, Hickory, Cedar, St. Clair, Barry, Barton, Jasper, and Newton counties.

Fimbristylis laxa Vahl.

Fimbristylis Baldwiniana Torr. (B & B).

High sandy prairies, banks, and moist places in glades, and gravel or sand bars along streams. Oxylophile. Central and southern Mo.: Madison, Mississippi, Dunklin, Cooper, Cedar, Jackson, Vernon, Greene, Jasper, Newton, and McDonald counties.

Fimbristylis Vahlii (Lam.) Link.

Moist sandy open ground. Oxylophile. Southern Mo., scattered: Wayne, Dunklin, and Barry counties.

Fimbristylis mucronulata (Michx.) Blake, Rh. **20**: 25. 1918.

Fimbristylis autumnalis of Am. auth. (G), (B & B).

Prairies and sandy fields. Oxylophile to circumneutral. Central and southern Mo.: St. Francois, Perry, New Madrid, Dunklin, Howell, Jackson, Jasper, and Newton counties.

Fimbristylis autumnalis (L.) R. & S. See Rh. **20**: 24. 1918.

Fimbristylis Frankii Steud. (G).

Fimbristylis geminata (Nees) Kunth (B & B).

Sandy fields, sandy open ground along streams, and prairies. Circumneutral to oxylophile. General.

Scirpus planifolius Muhl.

Dry open woods and shaded sandstone ledges. Oxylophile. Southern Mo.: Shannon and Douglas counties.

Scirpus americanus Pers. Three-square.

Wet woods, sloughs, swamps, and alluvial banks of streams. Circumneutral to oxylophile. General and common.

Scirpus validus Vahl. Great Bulrush.

Wet prairies and borders of sloughs and ponds. Circumneutral. General.

Scirpus acutus Muhl. See Rh. **22**: 55–56. 1920.

Scirpus occidentalis (Wats.) Chase (G), (B & B).

Ponds and sloughs. Calciphile to circumneutral. Scattered in northern and western Mo.: Adair, Saline, Holt, Buchanan, Andrew, Platte, Jackson, and Greene counties.

Scirpus campestris Britton. Bayonet Grass.
Sandy open ground. Calciphile to circumneutral. Northwestern Mo., local: Holt Co.

Scirpus fluviatilis (Torr.) Gray. River Bulrush.
Wet ground along streams, and borders of ponds and sloughs. Circumneutral. General.

Scirpus atrovirens Muhl. Common Bulrush.
Boggy or swampy open ground. Circumneutral. General.

Scirpus atrovirens var. **georgianus** (Harper) Fernald, Rh. **23**: 134. 1921.
Scirpus georgianus Harper (G).
Low wet woods. Circumneutral to oxylophile. Southeastern Mo.: Iron Co.

Scirpus pallidus (Britton) Fernald.
Wet open ground. Circumneutral. Western Mo.: Dekalb and Jasper counties.

Scirpus divaricatus Ell.
Swamps and low wet woods. Circumneutral. Southeastern Mo.: Dunklin, Butler, and Ripley counties.

Scirpus lineatus Michx.
Wet prairies and bogs. Circumneutral. General.

Scirpus pedicellatus Fernald.
Sloughs and ponds. Circumneutral. Northern Mo.: Putnam and Adair counties.

Scirpus Eriophorum Michx.
Swamps and low wet woods. Circumneutral. General but scattered: Lincoln, Iron, Stoddard, Dunklin, Butler, Caldwell, and Jackson counties.

Scirpus carinatus Gray.
Glades, barrens, and sandy open ground. Oxylophile. Southern Mo., rare: Dunklin, Jasper, Newton, and McDonald counties.

Fuirena simplex Vahl. Umbrella grass.
Bogs and swampy open ground. Circumneutral to calciphile. Northwestern, central, and southern Mo., mostly in the eastern Ozark region: Washington, Crawford, St. Francois, Iron, Dent, Wayne, Ripley, Shannon, Texas, Holt, and Jackson counties.

Hemicarpha micrantha (Vahl) Pax.
Sand bars along streams, borders of ponds, and wet depressions in glades. Circumneutral to oxylophile. General but scattered: Clark, Lincoln, St. Louis, Jefferson, Franklin, Perry, Bollinger, Mississippi, Dunklin, Butler, Wayne, Reynolds, Oregon, Howell, Miller, Pulaski, Holt, Jackson, Jasper, Barry, and Stone counties.

Hemicarpha micrantha var. **aristulata** Coville.
Sandy borders of ponds, lakes, and streams, and wet depressions in glades. Western Mo., scattered: Buchanan, Barry, and Stone counties.

Rynchospora corniculata (Lam.) Gray. Horned Rush.
Swamps, low wet woods, and along drainage canals. Circumneutral to oxylophile. Eastern Mo., mostly in the lowland counties: Audrain, St. Louis, Iron,

Cape Girardeau, Stoddard, New Madrid, Mississippi, Dunklin, and Butler counties.

Rynchospora macrostachya Torr.

Low swampy woods. Circumneutral. Southeastern Mo.: Bollinger, Stoddard, Pemiscot, Butler, and Ripley counties.

Rynchospora cymosa Ell.

Prairie swales, meadows, and wet rocky banks. Oxylophile to circumneutral. Southern Mo.: Madison, Shannon, St. Clair, Vernon, Barton, and Jasper counties. This has sometimes been confused with *R. compressa* which does not occur in Mo.

Rynchospora capillacea Torr.

Moist rocky ground and wet ledges along bluffs. Calciphile. Eastern Mo., south of the Missouri River: Jefferson, Washington, St. Francois, Ripley, Shannon, and Texas counties.

Rynchospora capitellata (Michx.) Vahl. See Rh. **20**: 27. 1918. False Bog Rush.

Rynchospora glomerata of auth., not Vahl (G), (B & B).

High prairies and rocky or sandy banks of streams. Oxylophile. Southern Mo.: St. Francois, Ste. Genevieve, Perry, Madison, Iron, Reynolds, Ripley, Dent, Howell, Shannon, Greene, Barton, and Jasper counties.

Scleria triglomerata Michx. Tall Nut-grass.

Rocky open woods, glades, and prairies. Oxylophile. General but scattered: Clark, Lewis, Macon, St. Louis, Jefferson, Iron, Reynolds, Dent, Shannon, Phelps, Howell, Mercer, Linn, Stone, Jackson, Barton, Jasper, Newton, McDonald, and Barry counties.

Scleria pauciflora Muhl.

Sandy prairies and barrens. Oxylophile. Southern Mo.: Jefferson, Iron, Shannon, Wright, Ozark, Jasper, and Barry counties.

Scleria pauciflora var. **caroliniana** (Willd.) Wood.

Rocky woods and glades. Oxylophile. Southwestern Mo.: Hickory, Jasper, and Newton counties.

Scleria oligantha Michx.

Rocky open woods and glades. Circumneutral. Southwestern Mo.: Ozark and Barry counties.

Scleria ciliata Michx.

Scleria Elliottii Chapm. (G).

High sandy prairies and open rocky woods. Oxylophile. Southern Mo.: Franklin, Washington, Iron, Carter, Shannon, Dent, Taney, Barry, Barton, Jasper, and McDonald counties.

Scleria setacea Poir.

Scleria reticularis Michx. var. *pubescens* Britton (G).

Open ground. Southwestern Mo., local: Greene Co.

Scleria verticillata Muhl.

Moist sandy open ground. Oxylophile. Southern Mo., scattered: Jefferson and McDonald counties.

Carex praegracilis Boott.

Carex camporum Mack. (B & B).

Dry open ground. Circumneutral. Introduced in Jackson Co. This has sometimes been confused with *Carex siccata* which does not occur in Mo.

Carex Sartwellii Dewey.

Low meadows. Circumneutral. Western Mo.: Jackson Co.

Carex retroflexa Muhl.

Dry open woods. Circumneutral. General: Schuyler, Shelby, Monroe, St. Louis, Jefferson, Franklin, Ste. Genevieve, Wayne, Butler, Dunklin, Shannon, Phelps, Laclede, Boone, Clay, Jackson, Jasper, and Stone counties.

Carex texensis (Torr.) Bailey.

Carex retroflexa var. *texensis* (Torr.) Fernald (G).

Swampy open ground. Circumneutral. Southeastern Mo.: Cape Girardeau Co.

Carex rosea Schkuhr.

Carex rosea var. *minor* Boott (G).

Dry rocky woods and prairies. Circumneutral. General.

Carex convoluta Mack. Bull. Torr. Bot. Club **43**: 428. 1916.

Carex rosea of auth., not Schkuhr (G), (B & B).

Dry rocky woods. Circumneutral. General.

Carex cephalophora Muhl.

Prairies, swales, meadows, and open woods. Circumneutral. General.

Carex Leavenworthii Dewey.

Prairies and open rocky woods. Circumneutral. General.

Carex mesochorea Mack. Bull. Torr. Bot. Club **37**: 246. 1910.

Central and southern Mo.: Lincoln, St. Louis, Jackson, Greene, and Stone counties.

Carex arkansana Bailey.

Prairie swales and open woods. Circumneutral. Southwestern Mo.: Jasper Co.

Carex Muhlenbergii Schkuhr.

Dry open woods and prairies. Circumneutral. General.

Carex Muhlenbergii var. **enervis** Boott.

Carex plana Mack. Bull. Torr. Bot. Club **50**: 350. 1923.

Dry prairies, meadows, and open ground. Circumneutral. General.

Carex austrina (Small) Mack.

Rocky prairies and glades. Circumneutral to calciphile. Western and southern Mo.: Shannon, Harrison, Jackson, Christian, Taney, and Jasper counties.

Carex gravida Bailey.

Carex gravida var. *laxifolia* Bailey, in part (G).

Prairies and dry open banks. Circumneutral. General.

Carex Lunelliana Mack. Bull. Torr. Bot. Club **42**: 615. 1915.

Carex gravida var. *laxifolia* Bailey, in part (G).

Prairies and dry open banks. Circumneutral. General.

Carex aggregata Mack. Bull. Torr. Bot. Club **37**: 246. 1910.

Prairie swales. Circumneutral to calciphile. Central and western Mo.: Washington, Osage, Jackson, and Jasper counties.

Carex cephaloidea Dewey.

Dry open ground and hillsides. Circumneutral. Scattered: St. Louis and Jackson counties.

Carex sparganioides Muhl.

Margins of ponds, bogs, and swampy woods. Circumneutral. General but scattered: Schuyler, Putnam, Knox, St. Louis, Jefferson, Washington, Shannon, Boone, Linn, Harrison, Atchison, Jackson, Dallas, Barton, Jasper, and Lawrence counties.

Carex triangularis Boeckl.

Swampy open ground. Oxylophile. Southeastern Mo.: Wayne and Dunklin counties.

Carex annectens Bicknell, Bull. Torr. Bot. Club **35**: 492. 1908.

Carex xanthocarpa var. *annectens* Bicknell.

Carex annectens var. *xanthocarpa* Wiegand.

Carex setacea var. *ambigua* (Barratt) Fernald, in part (G), (B & B).

Carex brachyglossa Mack. Bull. Torr. Bot. Club **50**: 355. 1923.

Prairies, dry open woods, and open soils. Circumneutral to oxylophile. General.

Carex vulpinoidea Michx. Fox Sedge.

Wet prairies, meadows, and borders of sloughs. Circumneutral. General.

Carex decomposita Muhl.

Swamps and boggy ground. Circumneutral. Southeastern Mo.: Dunklin, Dent, Shannon, and Texas counties.

Carex oklahomensis Mack. Torreya **14**: 126. 1914.

Prairie swales and borders of ponds and ditches. Circumneutral to calciphile. Western Mo.: Jackson, Jasper, and Newton counties.

Carex stipata Muhl.

Prairie swales and borders of ponds and ditches. Circumneutral. General but scattered: Shelby, Lincoln, St. Louis, Jefferson, Iron, Madison, Wayne, Butler, Shannon, Boone, Jackson, Jasper, and Newton counties.

Carex laevivaginata (Kükenth.) Mack. in B. & B. Ill. Fl. ed. 2, **1**: 371. 1913.

Wet meadows and open bogs. Circumneutral. Eastern Mo., local: St. Louis Co.

Carex crus-corvi Shuttlw.

Low wet woods, meadows, and swampy prairies. Circumneutral. General.

Carex conjuncta Boott.

Wet meadows, swamps, and prairie swales. Circumneutral. General: Scotland, Adair, Sullivan, Boone, St. Louis, Franklin, Howell, Stone, Clay, Jackson, and Jasper counties.

Carex interior Bailey.

Carex scirpoides Schkuhr (G).

Wet open ground. Circumneutral to oxylophile. Southeastern Mo.: Iron and Shannon counties.

Carex scoparia Schkuhr.

Carex scoparia var. *moniliformis* Tuckerm. (G), in part.

Prairie swales and wet meadows. Circumneutral. General but scattered: Scotland, Schuyler, Ralls, Audrain, St. Louis, Franklin, Howell, Boone, Jackson, Benton, Wright, Greene, and Jasper counties.

Carex tenera Dewey. See Rh. **23**: 235. 1921. Straw Sedge.

Carex straminea of Am. auth., not Willd. (G), (B & B).

Dry open woods and prairies. Circumneutral. General.

Carex normalis Mack. Bull. Torr. Bot. Club **37**: 244. 1910.

Carex mirabilis Dewey, not Host (G).

Carex mirabilis var. *perlonga* Fernald (G), in part.

Prairies and open woods. Circumneutral. General.

Carex festucacea Schkuhr.

Dry rocky ground, meadows, and prairies. Circumneutral. General.

Carex brevior (Dewey) Mack. Am. Midl. Nat. **4**: 235. 1915.

Carex molesta Mack.

Carex festucacea var. *brevior* (Dewey) Fernald (G).

Dry rocky ground, meadows, and prairies. Circumneutral. General.

Carex hormathodes Fernald.

Open swampy woods and prairies. Circumneutral. Southwestern Mo., local: Jasper Co.

Carex projecta Mack.

Low swampy ground. Circumneutral. Northeastern Mo.: Adair Co.

Carex Bicknellii Britton.

Dry open woods and prairies. Circumneutral. General.

Carex straminea Willd.

Prairie swales, meadows, and swampy open woods. Circumneutral to oxylophile. General.

Carex tribuloides Wahlenb.

Prairie swales and swampy open woods. Circumneutral. General.

Carex tribuloides var. **sangamonensis** Clokey, Rh. **21**: 84. 1919.

Occasionally found with the typical form. St. Louis, Boone, and Jackson counties.

Carex cristatella Britton.

Carex cristata Schwein., not Clairy (G).

Prairie swales, wet woods, and thickets. Circumneutral. Northern and central Mo.: Mercer, Adair, Knox, Monroe, Lincoln, St. Louis, Jefferson, Boone, Saline, Clay, and Jackson counties.

Carex muskingumensis Schwein.

Wet woods and swampy prairies. Circumneutral. Northern and central Mo.: Clark, Ralls, St. Louis, Jefferson, Adair, Livingston, and Jackson counties.

Carex Jamesii Schwein.

Rocky or rich woods and along base of bluffs and alluvial soils of river banks and ponds and sloughs. Circumneutral. General.

Carex physorhyncha Liebm.

Low wet woods. Circumneutral. Southeastern Mo., local: Dunklin Co. This has been confused with *Carex albicans* of some authors and *Carex Emmonsii* which do not occur in Missouri.

Carex pennsylvanica Lam. var. **digyna** Boeckl.

Carex pennsylvanica of auth. in part (G).

Carex heliophila Mack. Torreya **13**: 15. 1913.

Prairies, dry woods, and rocky open banks. Oxylophile. Northern and central Mo.: Schuyler, St. Louis, Daviess, Clay, and Jackson counties. *Carex heliophila* cannot be considered as specifically distinct from *Carex pennsylvanica*, and the Mo. material should be treated as a variety of the latter species.

Carex artitecta Mack. See N. Am. Fl. **18**: 189. 1935.

Carex varia Muhl., not Lumnitzer nor Host (G), (B & B).

Carex varia var. *colorata* Bailey, in part.

Dry rocky woods and prairies. Oxylophile. General.

Carex nigro-marginata Schwein.

Open woods. Circumneutral. Southeastern Mo.: Crowleys Ridge, Dunklin Co.

Carex umbellata Schkuhr.

Carex microrhyncha Mack. Bull. Torr. Bot. Club **40**: 548. 1913.

Rocky prairies, dry rocky or upland woods, and glades. Oxylophile. General: known north of the Missouri River in St. Charles, Warren, Montgomery, Callaway, Boone, Audrain, and Grundy counties. The Missouri material has been referred by Mackenzie to *Carex microrhyncha*, but this does not appear to be distinct from *Carex umbellata*.

Carex hirtifolia Mack. Bull. Torr. Bot. Club **37**: 244. 1910.

Carex pubescens Muhl., not Poir. (G), (B & B).

Rich woods, prairies, and meadows. Circumneutral. General.

Carex eburnea Boott.

Shaded limestone bluffs, and rarely on sandstone. Calciphile to circumneutral. Eastern, central, and southern Mo., south and east of a line from Lincoln, Monroe, Boone, Morgan, Benton, and Hickory counties to McDonald Co.

Carex tetanica Schkuhr.

Carex tetanica var. *Woodii* (Dewey) Bailey (G).

Carex Woodii Dewey.

Carex colorata Mack. (B & B).

Open ground. Circumneutral. Northwestern Mo.: Atchison Co.

Carex Meadii Dewey.

Carex tetanica var. *Meadii* (Dewey) Bailey (G).

Upland prairies, glades, and meadows. Calciphile to circumneutral. General and common. This has frequently been confused with *Carex Crawei*.

Carex Careyana Torr.

Rich or rocky woods. Circumneutral. East-central and southern Mo.: St. Louis, Shannon, Taney, and Stone counties.

Carex digitalis Willd.

Dry or rocky open woods and moist ledges. Circumneutral. Southern Mo.: Jefferson, Dunklin, Shannon, Douglas, Wright, and Taney counties.

Carex laxiculmis Schwein.
Rich woods. Circumneutral. Southeastern Mo., local: Ripley Co.

Carex laxiculmis var. **copulata** (Bailey) Fernald.
Rich or rocky woods. Circumneutral. Local: Shannon Co.

Carex albursina Sheldon. See Rh. **24**: 193. 1922.
Carex laxiflora var. *latifolia* Boott (G).
Rich woods. Circumneutral. General but not common.

Carex blanda Dewey. See Rh. **24**: 194. 1922.
Carex laxiflora var. *blanda* (Dewey) Boott (G).
Carex laxiflora var. *varians* of auth., not Bailey (G).
Rich or rocky woods. Circumneutral. General.

Carex laxiflora Lam. See Rh. **24**: 195. 1922.
Carex laxiflora var. *gracillima* Boott (G).
Rich woods and along shaded bluffs. Circumneutral. General.

Carex anceps Willd.
Carex laxiflora var. *patulifolia* (Dewey) Carey (G).
Rich woods and along rocky bluffs and ledges. Circumneutral. Western Mo.: Jackson, Jasper, Barry, and Stone counties.

Carex granularis Muhl.
Moist woods and meadows. Circumneutral. General.

Carex granularis var. **Haleana** (Olney) Porter.
Carex Shriveri Britton (B & B).
Moist meadows and low open ground. Circumneutral. Southern Mo., scattered: Wayne and Phelps counties.

Carex Crawei Dewey.
Wet places in glades. Calciphile. East-central and southern Mo.: Jefferson, Franklin, and Taney counties.

Carex oligocarpa Schkuhr.
Rich rocky woods and ledges along bluffs. Circumneutral. Central and southern Mo.: St. Louis, Jefferson, Franklin, Iron, Wayne, Shannon, Miller, Laclede, Boone, Clay, Jackson, Taney, Stone, Jasper, Newton, and McDonald counties.

Carex Hitchcockiana Dewey.
Rich woods and shaded bluffs. Circumneutral. General but scattered: St. Louis, Washington, Shannon, Mercer, and Jackson counties, and also recorded from Boone Co.

Carex amphibola Steud.
Carex grisea var. *angustifolia* Boott (G).
Rich alluvial or wet woods. Circumneutral. Southeastern and central Mo.: St. Louis, Jefferson, Iron, Mississippi, Dunklin, Butler, Shannon, and Jackson counties.

Carex grisea Wahlenb.
Prairie swales and moist woods. Circumneutral. General.

Carex grisea var. **rigida** Bailey.
Occasionally found with the typical form.

Carex grisea var. **globosa** Bailey.

In similar situations to the typical form. Local: Shannon Co.

Carex glaucodea Tuckerm.

Moist open ground and open woods. Circumneutral. Central and southern Mo.: St. Louis, Jefferson, Ste. Genevieve, St. Francois, Bollinger, Iron, Dunklin, Butler, Ripley, Shannon, Dent, Texas, Phelps, Boone, Douglas, and Webster counties.

Carex flaccosperma Dewey.

Swampy woods. Circumneutral. Southeastern Mo., local: Dunklin Co.

Carex gracillima Schwein.

Wet woods. Circumneutral. Southern and central Mo., scattered: St. Louis and Greene counties.

Carex oxylepis Torr. & Hook.

Rich low woods. Circumneutral. Southeastern Mo.: Dunklin and Butler counties.

Carex Davisii Schwein. & Torr.

Moist or rich woods, meadows, and borders of streams. General: Shelby, Marion, Ralls, Lincoln, St. Charles, St. Louis, Franklin, Stoddard, Shannon, Phelps, Boone, Schuyler, Scotland, Putnam, Mercer, Harrison, Gentry, Clay, Jackson, Johnson, Greene, Jasper, and Newton counties.

Carex cherokeensis Schwein.

Swampy ground. Circumneutral. Southeastern Mo.: Butler Co.

Carex virescens Muhl.

Wet woods and swampy open ground. Circumneutral. Southeastern Mo.: Scott, Dunklin, Butler, and Ripley counties.

Carex hirsutella Mack. Bull. Torr. Bot. Club **50**: 349. 1923.

Carex triceps var. ***hirsuta*** (Willd.) Bailey (G).

Carex complanata Torr. (B & B).

Dry rocky woods and prairies. Oxylophile. General.

Carex caroliniana Schwein.

Carex triceps var. *Smithii* Porter (G).

Wet woods and prairie swales. Circumneutral. Central and southern Mo.: St. Louis, Jefferson, St. Francois, and Jasper counties.

Carex Bushii Mack. Bull. Torr. Bot. Club **37**: 241. 1910.

Wet open ground. Circumneutral. Northern and western Mo.: Adair, Jackson, and Jasper counties.

Carex leptalea Wahlenb.

Moist bluffs and wet open ground. Calciphile to circumneutral. Southern Mo., local: Laclede, Washington, and Shannon counties.

Carex Joorii Bailey.

Carex macrokolea Steud. (G).

Swamps and low wet woods. Circumneutral. Southeastern Mo.: Dunklin Co.

Carex Shortiana Dewey.

Swales, meadows, and borders of ponds and streams. Circumneutral. General.

Carex Buxbaumii Wahlenb.

Swampy ground and prairies. Circumneutral. Scattered: Marion, Butler, and Clinton counties.

Carex stricta Lam. Tussock Sedge.

Carex stricta var. *angustata* (Boott) Bailey, in part.

Swampy woods and prairies. Circumneutral. Scattered: Shannon, Jackson, Jasper, and Greene counties.

Carex Haydeni Dewey.

Carex stricta var. *decora* Bailey (G).

Prairie swales. Circumneutral. Northern and western Mo., local: Jackson and Adair counties.

Carex scabrata Schwein.

Wet open or rocky ground. Circumneutral. Southwestern Mo., local: Greene Co.

Carex torta Boott.

Swamps and banks of streams. Oxylophile to circumneutral. Southern Mo.: Washington, Ste. Genevieve, Ripley, Iron, Shannon, and Webster counties.

Carex Emoryi Dewey.

Wet woods and prairie swales. Circumneutral. Scattered: Jackson and Mercer counties.

Carex crinita Lam. Fringed Sedge.

Prairie swales, sloughs, and margins of ponds and streams. Circumneutral. General.

Carex crinita var. **gynandra** (Schwein.) Schwein. & Torr.

Carex gynandra Schwein.

Prairie swales, sloughs, and margins of ponds. Circumneutral. Scattered: Ripley and Jackson counties.

Carex lacustris Willd.

Carex riparia Curtis (G).

Carex riparia var. *lacustris* (Willd.) Kükenth.

Low wet woods and swamps. Circumneutral. General.

Carex hyalinolepis Steud.

Carex impressa (S. H. Wright) Mack. Bull. Torr. Bot. Club **37**: 236. 1910. (B & B).

Carex riparia var. *impressa* S. H. Wright.

Swampy woods and borders of sloughs. Circumneutral. General.

Carex lanuginosa Michx.

Prairie swales and boggy ground. Circumneutral. General.

Carex laeviconica Dewey.

Carex trichocarpa var. *Deweyi* Bailey (G), in part.

Carex trichocarpa var. *imberbis* Gray (G), in part.

Carex trichocarpa Muhl. (B & B), in part.

Low wet ground. Circumneutral. Local: Schuyler and Jackson counties.

Carex atherodes Spreng.

Carex trichocarpa var. *aristata* (R. Br.) Bailey (G).

Low swampy ground. Circumneutral. Local: Jackson Co.

Carex vesicaria L.

Meadows and low ground. Circumneutral. Local: St. Louis Co.

Carex vesicaria var. **monile** (Tuckerm.) Fernald.

Carex monile Tuckerm.

Meadows and low ground. Circumneutral. Northern and central Mo.: Scotland, Adair, St. Louis, Saline, and Jackson counties.

Carex lurida Wahlenb.

Carex lurida var. *flaccida* Bailey, in part.

Wet woods, swales, and borders of sloughs and streams. Circumneutral. General.

Carex comosa Boott.

Swampy ground. Circumneutral. Central-western and southeastern Mo.: Platte, Dunklin, and Butler counties.

Carex hystricina Muhl.

Rich moist woods and swales. Circumneutral. Central and southern Mo.: St. Louis, Jefferson, Washington, Iron, Shannon, Texas, Ripley, Saline, Jackson, and Greene counties. This species and *Carex lurida* have been confused with *Carex Schweinitzii* which is not known to occur in Mo.

Carex Frankii Kunth.

Prairie swales and borders of sloughs and streams. Circumneutral. General.

Carex squarrosa L.

Wet woods and prairies. Circumneutral. General.

Carex typhina Michx.

Carex typhinoides Schwein. (G).

Wet woods and swamps. Circumneutral. Northern, central, and eastern Mo.: Scotland, Adair, Shelby, Audrain, St. Louis, Franklin, Phelps, Bollinger, Wayne, Butler, Ripley, Boone, Linn, Livingston, and Jackson counties.

Carex intumescens Rudge.

Low woods and swampy open ground. Circumneutral. Southeastern Mo.: Cape Girardeau, Dunklin, Butler, and Ripley counties.

Carex Asa-Grayi Bailey.

Carex Grayii var. *hispidula* Gray (G), in part.

Low wet woods and sloughs. Circumneutral. General.

Carex louisianica Bailey.

Carex Halei Carey, not Dewey (G).

Swamps and wet woods. Circumneutral. Southeastern Mo.: New Madrid, Dunklin, and Butler counties.

Carex lupuliformis Sartwell.

Swampy ground. Circumneutral. Northern and central Mo., rare and scattered: St. Louis and Livingston counties.

Carex lupulina Muhl. Hop Sedge.

Carex lupulina var. *pedunculata* Dewey (G), in part.

Wet meadows, swampy woods, and borders of sloughs. Circumneutral. General.

Carex gigantea Rudge.

Swampy woods and wet open ground. Circumneutral. Southeastern Mo.: Dunklin, Butler, and Ripley counties.

Fam. Araceae

Arisaema triphyllum (L.) Schott. Indian Turnip, Jack-in-the-pulpit.

Rich or rocky woods and alluvial thickets. Circumneutral. General.

Arisaema Dracontium (L.) Schott. Green Dragon.

Rocky woods and thickets, in moister situations than the preceding. Circumneutral. General.

Peltandra virginica (L.) Kunth. Arrow Arum.

Boggy ground and borders of sloughs and ponds. Circumneutral. East-central Mo.: St. Charles, St. Louis, and Jefferson counties.

Peltandra virginica f. **hastifolia** Blake, Rh. **14**: 105. 1912.

Wet or boggy ground. Circumneutral. Southeastern Mo.: Dunklin Co.

Acorus Calamus L. Sweet Flag.

Wet prairies and meadows, and borders of sloughs and ponds. Circumneutral. General.

Fam. Lemnaceae

Spirodela polyrhiza (L.) Schleid. Duckweed.

Ponds and sloughs. General but not common.

Spirodela oligorhiza (Kurz) Hegelm. See Bull. Torr. Bot. Club **61**: 233–236. 1934.

Slow-flowing streams and sloughs. Local: Jackson Co.

Lemna trisulca L. Ivy-leaved Duckweed.

Stagnant pools, slow streams, and deep springs. Circumneutral. Central and southern Mo., scattered: Shannon, Oregon, and Jackson counties.

Lemna valdiviana Philippi. See Rh. **37**: 75. 1935.

Lemna cyclostasa (Ell.) Chev. (B & B).

Ponds and sloughs. Circumneutral. Central and southern Mo., scattered: St. Francois, Dunklin, Oregon, and Jackson counties.

Lemna perpusilla Torr.

Ponds and sloughs. Central and southern Mo.: St. Louis, Dent, Boone, Saline, Jackson, Cass, and Greene counties.

Lemna perpusilla var. **trinervis** Aust.

Ponds. Occasionally found with the typical form. Jackson Co.

Lemna minor L. Little Duckweed.

Ponds, sloughs, and stagnant streams. Circumneutral. General.

Wolffia columbiana Karst.

Ponds and sloughs. Circumneutral. Central Mo., and perhaps more general: St. Louis, Boone, and Jackson counties.

Wolffia papulifera C. H. Thompson.

Sloughs, ponds, and rivers. Circumneutral. Scattered: Dunklin and Boone counties.

Wolffiella floridana (J. D. Sm.) C. H. Thompson.

Stagnant water. Circumneutral. Southeastern Mo.: Dunklin Co., in Varney and St. Francis rivers.

Fam. COMMELINACEAE

Tradescantia subaspera Ker-Gawl. See Contr. Arn. Arb. 9: 48. 1935.

Tradescantia pilosa Lehm. (G), (B & B).

Rich woods, shaded bluffs, and banks of streams. Circumneutral. Eastern and middle Mo.: Marion, Monroe, Ralls, Pike, Boone, Callaway, Montgomery, Warren, St. Louis, Jefferson, Franklin, Washington, Crawford, Ripley, Oregon, Shannon, Texas, Maries, Pulaski, Osage, Miller, Moniteau, Morgan, and Ozark counties.

Tradescantia canaliculata Raf. See Contr. Arn. Arb. 9: 74. 1935.

Tradescantia reflexa Raf. (G), (B & B).

Rocky prairies, moist banks, thickets, and open woods. Circumneutral. General.

Tradescantia virginiana L. See Contr. Arn. Arb. 9: 60. 1935. Spiderwort.

Tradescantia brevicaulis Raf., not of recent auth.

Rich moist ledges along bluffs, and alluvial woods. Circumneutral to calciphile. Eastern and central Mo.: Pike, Lincoln, St. Charles, St. Louis, Jefferson, Washington, Ste. Genevieve, Iron, Madison, Wayne, Carter, Ripley, Montgomery, Boone, Clinton, and Jackson counties.

Tradescantia bracteata Small. See Contr. Arn. Arb. 9: 85. 1935.

Prairies, thickets, and meadows, and also often introduced along railway embankments and roadsides. Circumneutral to oxylophile. Northern and central Mo.: Scotland, Pike, Lincoln, St. Charles, St. Louis, Jefferson, Atchison, Jackson, Cass, and Henry counties.

Tradescantia longipes Anderson & Woodson, Contr. Arn. Arb. 9: 91. 1935.

Tradescantia brevicaulis of auth. in part, not Raf. (G), (B & B).

Rocky hillsides and sandy or rocky open woods. Oxylophile. Eastern Ozark region: Crawford, Washington, Madison, St. Francois, Iron, Reynolds, Wayne, Carter, Shannon, Dent, Texas, Howell, and Douglas counties.

Tradescantia Tharpii Anderson & Woodson, Contr. Arn. Arb. 9: 70. 1935.

Tradescantia brevicaulis of auth. in part, not Raf. (G), (B & B).

Rocky prairies and hillsides. Circumneutral. Southwestern Mo.: Greene, Lawrence, and Jasper counties.

Tradescantia ozarkana Anderson & Woodson, Contr. Arn. Arb. 9: 56. 1935.

Rich rocky woods and moist ledges along bluffs. Circumneutral to calciphile. Southwestern Mo., local: Barry Co.

Tradescantia Ernestiana Anderson & Woodson, Contr. Arn. Arb. 9: 58. 1935.

Rocky wooded hillsides and ledges along bluffs. Circumneutral. Southwestern Mo.: Douglas, Taney, Barry, Jasper, and Newton counties.

Commelina communis L. Creeping Day-flower.

Wet alluvial cultivated or waste ground, and in woods and thickets. General. Sometimes becoming a troublesome weed.

Commelina caroliniana Walt.
Fields and waste ground. Indifferent. Introduced in Jackson Co.

Commelina virginica L. See Bull. Torr. Bot. Club **43**: 97–111. 1916.
Commelina hirtella of auth., not Vahl (G), (B & B).
Moist alluvial ground along streams, and margins of swamps and sloughs. Central and southern Mo.: St. Louis, Jefferson, Bollinger, Scott, Mississippi, New Madrid, Pemiscot, Dunklin, Butler, Wayne, Carter, Ripley, Oregon, Shannon, Phelps, Pulaski, Laclede, Jackson, Cedar, St. Clair, Greene, Barry, Jasper, Newton, and McDonald counties.

Commelina erecta L. Day-flower.
Commelina virginica of auth., not L. (G), (B & B).
Bluffs and hillsides, sandy and rocky woods, alluvial banks, and gravel and sand bars along Ozark streams. Oxylophile to circumneutral. General: Mercer, Linn, Warren, Montgomery, Maries, Franklin, Jefferson, Dent, Reynolds, Shannon, Oregon, Texas, Pulaski, Miller, Camden, Laclede, Dallas, Morgan, Hickory, Polk, Cedar, Douglas, Ozark, Andrew, Jackson, Vernon, Jasper, Barry, and McDonald counties.

Commelina erecta var. **crispa** (Wooton) Palmer & Steyermark, comb. nov.
Commelina crispa Wooton (B & B).
Exposed rocky ledges and glades. Circumneutral to calciphile. General but scattered: Putnam, Mississippi, Ripley, Jackson, Jasper, and McDonald counties.

Commelina longicaulis Jacq. See Bull. Torr. Bot. Club. **43**: 96. 1916.
Commelina nudiflora of Am. auth., not L. (B & B).
Moist open or cultivated ground, in sandy or alluvial soil, frequently a weed in low fields. Circumneutral. General: Shelby, Lincoln, Randolph, Saline, St. Charles, St. Louis, Jefferson, Madison, Scott, New Madrid, Pemiscot, Dunklin, Ripley, Oregon, Howell, Shannon, Miller, Henry, Pettis, Douglas, Barry, Vernon, and Jasper counties.

Fam. Xyridaceae

Xyris flexuosa Muhl.
Moist borders of streams and ponds. Circumneutral. Local: Greene Co.

Fam. Pontederiaceae

Eichhornia crassipes (Mart.) Schlecht. Water Hyacinth.
Introduced along drainage canals. Butler Co.

Pontederia cordata L. Pickerel-weed.
Ponds and sloughs. Circumneutral. Central and southern Mo.: Lincoln, St. Charles, Jefferson, Crawford, Stoddard, Ray, Jackson, Barton, Jasper, and Newton counties.

Heteranthera limosa (Sw.) Willd.
Slow streams, ponds, and sloughs. Circumneutral. Central and southern Mo.: Montgomery, St. Louis, Jefferson, New Madrid, Dent, Ray, Jackson, Greene, Ozark, Taney, Jasper, and McDonald counties.

Heteranthera reniformis R. & P. Mud Plantain.

Ponds and sloughs. Circumneutral. General but scattered, and mainly along the larger rivers: Lincoln, St. Charles, St. Louis, Jefferson, Dunklin, Shannon, Boone, Holt, Clay, Jackson, and Greene counties.

Heteranthera dubia (Jacq.) MacM. Water Star-grass.

Streams and sloughs. Circumneutral. Central, southern, and northwestern Mo., mainly in the Ozark region, and scattered elsewhere: St. Louis, Jefferson, Franklin, Gasconade, Crawford, Dent, Reynolds, Wayne, Butler, Dunklin, Ripley, Oregon, Carter, Texas, Pulaski, Osage, Miller, Camden, Dallas, Laclede, Douglas, Ozark, Taney, Stone, Greene, Holt, and Jackson counties.

Fam. JUNCACEAE

Juncus bufonius L. Toad Rush.

Sandy and gravelly ground along the larger rivers. Oxylophile. West-central Mo.: Clay and Jackson counties.

Juncus macer S. F. Gray. See Jour. Bot. **68**: 366. 1930. Slender Rush.

Juncus tenuis of auth., not Willd. (G), (B & B).

Juncus monostichus Bartlett (G).

Fields, roadsides, waste ground, and wet places. Indifferent. General and common. True *Juncus tenuis* Willd. *(Juncus dichotomus* Ell. and auth.) has been misidentified in Missouri and is not known from the state. *Juncus monostichus* is considered only an abnormal form of *Juncus macer* and is treated here as identical with the latter species.

Juncus macer var. **anthelatus** (Wiegand) Fernald, Jour. Bot. **68**: 367. 1930.

Juncus tenuis var. *anthelatus* Wiegand (G).

Occasionally found with the typical form. Scotland, Shelby, Boone, Scott, Wayne, Ripley, Mercer, Saline, and Jasper counties.

Juncus interior Wiegand.

Upland prairies and meadows. Circumneutral to oxylophile. General.

Juncus kansanus Hermann, Papers Mich. Acad. Sci. **20**: 41. 1935.

Dry rocky open ground. Circumneutral. Northeastern Mo., local: Pike Co.

Juncus secundus Beauv.

Dry upland prairies, sandy or rocky ground. Oxylophile. Eastern and southern Mo.: Lincoln, Jefferson, St. Francois, Dent, Phelps, Texas, and Laclede counties.

Juncus Dudleyi Wiegand.

Moist prairies, meadows, and wet places along streams. Circumneutral. Central and southern Mo.: Crawford, Iron, Shannon, Phelps, Dallas, and Jackson counties.

Juncus effusus L. var. **solutus** Fernald & Wiegand, Rh. **12**: 90. 1910. Rush.

Prairie swales and borders of ponds, sloughs, and streams. Circumneutral. General.

Juncus balticus Willd. var. **littoralis** Engelm.

Sand bars and alluvial ground along Missouri River. Circumneutral. Local: Jackson Co.

Juncus canadensis J. Gay.

Moist ground along streams. Southern Mo., local: Howell Co.

Juncus subcaudatus (Engelm.) Coville & Blake, Proc. Biol. Soc. Wash. **31**: 45. 1918.

Juncus canadensis var. *subcaudatus* Engelm. (G).

Moist ground along rocky beds of streams and slopes. Calciphile. Southeastern Mo.: Texas and Iron counties.

Juncus nodosus L. Knotted Rush.

Sand bars of Missouri River. Introduced in Jackson Co.

Juncus Torreyi Coville.

Borders of ponds, sloughs, and eroded banks. Circumneutral. General. Small-headed forms of this have been confused with *J. nodosus.*

Juncus brachycarpus Engelm.

Prairies, swales, wet meadows, and wet sandy borders of small streams. Circumneutral to oxylophile. Southern and central Mo.: Boone, St. Louis, Jefferson, Crawford, Iron, Scott, Mississippi, Wayne, Shannon, Phelps, Howell, Ozark, Webster, Greene, Vernon, Jasper, McDonald, and Barry counties.

Juncus validus Coville.

Juncus polycephalus of auth. in part, not Michx. (G), (B & B).

Prairie swales and swampy ground. Oxylophile to circumneutral. Southwestern Mo.: Jasper and Vernon counties. This species has been confused with *Juncus polycephalus* which is not known in Mo.

Juncus scirpoides Lam.

Wet open or swampy ground. Circumneutral. Central and southern Mo.: St. Louis, Mississippi, Wayne, Howell, and Greene counties.

Juncus acuminatus Michx. Knotty-leaved Rush.

Borders of ponds, sloughs, and ditches. Circumneutral. General.

Juncus alpinus Vill. var. **fuscescens** Fernald.

Low sandy ground along Missouri River. Circumneutral. Western Mo., local: Jackson Co.

Juncus diffusissimus Buckley.

Wet meadows, bogs, and borders of ponds, streams, and sloughs. Circumneutral to oxylophile. Central and southern Mo.: Miller, Crawford, Shannon, Ripley, Howell, Benton, Henry, Cedar, Vernon, Barton, Jasper, and McDonald counties.

Juncus nodatus Coville.

Juncus robustus (Engelm.) Coville, not Wats. (G).

Sandy open ground, borders of streams and sloughs. Oxylophile. Southern and east-central Mo.: St. Louis, Bollinger, Wayne, Butler, Howell, Barton, and Jasper counties.

Juncus marginatus Rostk. See Rh. **37**: 156. 1935.

Juncus aristulatus Michx.

Prairies, meadows, and open sandy ground. Circumneutral to oxylophile. Eastern, central, and southern Mo.: Clark, Marion, Audrain, Boone, St. Louis, Jefferson, St. Francois, Mississippi, Dunklin, Wayne, Iron, Carter, Butler,

Ripley, Crawford, Phelps, Shannon, Howell, Henry, Cedar, Greene, Vernon, Barton, Jasper, Newton, McDonald, and Barry counties.

Juncus marginatus var. **setosus** Coville.

Occasionally found with the typical form. Southern Mo.: Shannon, Greene, Jasper, and Newton counties.

Juncus biflorus Ell. See Rh. **37**: 156. 1935.

Juncus aristulatus of Bicknell and later auth., not Michx. (G).

Moist sandy open ground. Oxylophile. Southern and east-central Mo.: St. Louis, Butler, Iron, Wayne, Phelps, Texas, Greene, Jasper, Barry, and McDonald counties.

Juncus biflorus f. **adinus** Fernald & Griscom, Rh. **37**: 157. 1935.

Wet meadows and swampy ground. Oxylophile. Scattered: St. Louis and Jasper counties.

Luzula campestris (L.) DC. var. **bulbosa** A. Wood.

Dry rocky prairies, meadows, glades, and dry open woods, sometimes in sandy alluvial ground. Oxylophile. Central and southern Mo. south and east of a line drawn from St. Louis, Warren, Montgomery, and Callaway counties to Henry and Vernon counties.

Fam. LILIACEAE

Amianthium muscaetoxicum (Walt.) Gray. Fly Poison.

Chrosperma muscaetoxicum (Walt.) Kuntze (B & B).

Sandy woods. Oxylophile. Southern Mo., rare and scattered: Carter, Ripley, and Greene counties.

Stenanthium gramineum (Ker) Kunth.

Moist meadows and rich woods along bluffs. Circumneutral. Eastern and middle Mo.: St. Louis, Jefferson, St. Francois, Madison, Ripley, Shannon, and Phelps counties.

Stenanthium gramineum f. **robustum** (Wats.) Palmer & Steyermark, comb. nov.

Stenanthium robustum Wats. (G), (B & B).

Moist rocky woods and thickets. Circumneutral. East-central and southern Mo., scattered: St. Louis, Lawrence, and Jasper counties.

Zigadenus elegans Pursh. See Rh. **37**: 256–257. 1935.

Moist shaded limestone bluffs. Calciphile. Local: Shannon Co. This species has been confused with *Zigadenus glaucus* Nutt. (*Z. chloranthus* Richards.), which is not known to occur in Mo.

Zigadenus Nuttallii (Gray) Wats.

Toxicoscordion Nuttallii (Gray) Rydb. (B & B).

Dry rocky limestone slopes and glades. Calciphile. Local: Oregon Co.

Melanthium virginicum L. Bunch-flower.

Wet meadows, thickets, and marshy ground below bluffs. Circumneutral. General but scattered: : Linn, Adair, Knox, Pike, St. Louis, Jefferson, Franklin, Washington, Phelps, Iron, Shannon, Boone, Webster, Greene, Jackson, Cass, Johnson, and Jasper counties.

Veratrum Woodii Robbins. False Hellebore.

Rich or rocky woods. Circumneutral. Eastern, middle, and southern Mo.: Mercer, Sullivan, Adair, Schuyler, Knox, Shelby, Marion, Ralls, Boone, Callaway, Lincoln, Warren, St. Louis, Jefferson, Franklin, St. Francois, Madison, Bollinger, Iron, Crawford, Dent, Shannon, Reynolds, Oregon, Texas, Howell, Taney, Wright, and Barry counties.

Uvularia grandiflora Sm. Straw-flower, Large Bellwort.

Rich alluvial or rocky woods. Circumneutral. General but absent from most of the western prairie counties. This species has sometimes been confused with *U. perfoliata,* which is not known in Mo.

Oakesia sessilifolia (L.) Wats. Small Bellwort, Wild Oats.

Rich alluvial or low woods, and along shaded banks and bluffs. Circumneutral. Scattered, and mostly in northern Mo.: Harrison, Boone, Knox, Audrain, and Jasper counties.

Allium cernuum Roth. Nodding Wild Onion.

Rocky ledges along bluffs. Calciphile. East-central and southern Mo.: Jefferson, Franklin, Washington, Crawford, Dent, Phelps, Pulaski, Shannon, and Greene counties.

Allium stellatum Ker.

Glades and exposed rocky ledges along bluffs. Calciphile. Central and southern Mo.: Lincoln, St. Louis, Jefferson, Franklin, Ste. Genevieve, St. Francois, Madison, Washington, Crawford, Phelps, Maries, Pulaski, Dent, Shannon, Texas, Laclede, Boone, Henry, Benton, Dallas, Greene, Wright, Webster, Douglas, Ozark, Taney, and Barry counties.

Allium canadense L. Wild Garlic.

Moist open woods, meadows, prairies, and thickets. Indifferent. General.

Allium Nuttallii Wats.

Glades and dry rocky ledges. Calciphile. Southwestern Mo., local: McDonald Co.

Allium mutabile Michx. Wild Onion.

Limestone glades, barrens, and prairies. Calciphile. General but mostly in central and southern Mo.: Montgomery, Jefferson, St. Francois, Madison, Iron, Dent, Maries, Laclede, Ozark, Wright, Webster, Greene, Boone, Daviess, Jackson, Vernon, Jasper, Newton, and McDonald counties.

ALLIUM SATIVUM L.

Fields, waste ground, and along railroads and roadsides. Indifferent. General.

ALLIUM VINEALE L. Crow Garlic.

Moist fields and meadows. Indifferent. Scattered: St. Louis, Franklin, Boone, and Jasper counties.

Allium tricoccum Ait. Wild Leek.

Low rich woods and slopes along bluffs. Circumneutral. Northern and central Mo., scattered and rare: Mercer, Boone, and St. Louis counties.

Nothoscordum bivalve (L.) Britton. False Garlic.

Glades, barrens, and prairies. Circumneutral. General but commonest in the Ozark region.

HEMEROCALLIS FULVA L. Day Lily.
Escaped from gardens to fields and roadsides. Indifferent. General.

LILIUM TIGRINUM Ker. Tiger Lily.
Occasionally found as an escape from cultivation.

Lilium michiganense Farwell, Bull. Torr. Bot. Club **42**: 353. 1915. Turk's-cap Lily.
Lilium superbum of auth., not L. (G), (B & B).
Rich open woods, prairie swales, and meadows. Circumneutral. General but not common: Knox, Adair, Livingston, Chariton, Mercer, Boone, Callaway, St. Louis, Jefferson, Franklin, Washington, Crawford, Dent, Iron, Saline, Jackson, Johnson, Benton, Webster, Greene, Jasper, and Newton counties.

Erythronium americanum Ker. Yellow Adder's-tongue, Yellow Dog-tooth Violet.
Rich alluvial woods along bluffs and streams. Circumneutral. Southern and east-central Mo.: Boone, St. Louis, Franklin, Ste. Genevieve, Iron, Shannon, Howell, Taney, Greene, Barry, Jasper, and McDonald counties.

Erythronium albidum Nutt. White Adder's-tongue, White Dog-tooth Violet.
Rich woods along bluffs and streams. Circumneutral. General.

Erythronium mesochoreum Knerr. Prairie Dog-tooth Violet.
Rocky prairies, glades, and dry open woods. Circumneutral to calciphile. Central and southern Mo.

Camassia hyacinthina (Raf.) Palmer & Steyermark, comb. nov. Wild hyacinth.
Lemotris hyacinthina Raf.
Camassia esculenta (Ker) Robinson, not Lindl. (G), (B & B).
Rocky glades and prairies. Calciphile to circumneutral. General.

SCILLA BIFLORA L.
Occasionally escaped from cultivation; in open woods and fields. Pike Co.

MUSCARI BOTRYOIDES (L.) Mill. Grape Hyacinth.
Escaped from cultivation; in fields and waste ground. Scattered: Jefferson and Taney counties.

Yucca glauca Nutt. Bear Grass.
Loess hills. Calciphile. Northwestern Mo.: Atchison and Holt counties.

Yucca arkansana Trelease.
Rocky open woods and bluffs. Circumneutral. Southwestern Mo.: Stone Co.

Yucca filamentosa L. Needle-and-thread, Spanish Bayonet.
Frequently escaped from cultivation; in open woods, thickets, and along railroads and roadsides. General but scattered.

ORNITHOGALUM NUTANS L. Star of Bethlehem.
Occasionally escaped from gardens to fields and lawns. Boone Co.

ORNITHOGALUM UMBELLATUM L. Star of Bethlehem.
Escaped from cultivation; in fields, meadows, and on shaded banks. Scattered: Marion, St. Louis, Jefferson, Perry, Callaway, Boone, Cole, Jackson, and Vernon counties.

ASPARAGUS OFFICINALIS L. Asparagus.

Frequently escaped from cultivation; along roads and in fields and waste ground. General.

Smilacina racemosa (L.) Desf. False Spikenard, False Solomon's Seal.

Rich or rocky woods. Circumneutral. General.

Smilacina stellata (L.) Desf. False Solomon's Seal.

Moist rich woods. Circumneutral. Northern and central Mo., scattered: Shelby, Boone, and Jackson counties.

Medeola virginiana L. Indian Cucumber-root.

Moist shaded banks along streams. Circumneutral. Northern Mo., local: Linn Co.

Polygonatum canaliculatum (Muhl.) Pursh. Large Solomon's Seal.

Polygonatum giganteum Dietr., in part (R).

Polygonatum commutatum (R. & S.) Dietr., in part (G), (B & B).

Rich or rocky woods and alluvial thickets and banks. Circumneutral. General.

Polygonatum canaliculatum var. **ovatum** (Farwell) Palmer & Steyermark, comb. nov.

Polygonatum biflorum ovatum Farwell, Bull. Torr. Bot. Club **42**: 255. 1915.

Polygonatum commutatum ovatum (Farwell) Gates.

Polygonatum ovatum (Farwell) Bush.

Rich woods and thickets. Circumneutral. Western Mo.: Jackson Co.

Trillium sessile L. Wake-Robin.

Rich alluvial or rocky woods. Circumneutral. Central and southern Mo.: St. Louis, Jefferson, Franklin, Shannon, Dent, Iron, Wayne, Oregon, Warren, Montgomery, Callaway, Audrain, Randolph, Gasconade, Osage, Moniteau, Boone, Cole, Phelps, Pulaski, Laclede, Texas, Howell, Morgan, Cooper, Chariton, Jackson, Johnson, Bates, Benton, Hickory, Polk, St. Clair, Greene, Christian, Taney, Douglas, Wright, Webster, Barry, Jasper, Newton, and McDonald counties.

Trillium sessile f. **luteum** Peattie.

Trillium sessile viridiflorum Beyer.

Occasionally found with the typical form: St. Louis and Moniteau counties.

Trillium viride Beck.

Open rocky woods and banks. Circumneutral. Eastern Mo.: Pike, Callaway, Warren, St. Louis, Franklin, and Iron counties.

Trillium viridescens Nutt.

Rocky or alluvial open woods. Circumneutral. Southwestern Mo.: Ozark, Taney, Stone, and Barry counties.

Trillium recurvatum Beck.

Rich alluvial woods and thickets and rocky slopes or base of bluffs. Circumneutral to calciphile. Eastern and central Mo., and locally southwestwards to Douglas Co.: St. Louis, Jefferson, Franklin, Washington, St. Francois, Ste. Genevieve, Perry, Cape Girardeau, Bollinger, Dunklin, Butler, Ripley, Wayne, Iron, Carter, Oregon, Boone, Howard, Cooper, Saline, Howell, and Douglas counties.

Trillium recurvatum f. Shayi Palmer & Steyermark, nom. nov.

Trillium recurvatum f. *luteum* Friesner, Butler Univ. Bot. Stud. 3: 31. 1929, not *Trillium recurvatum* f. *luteum* Clute, Am. Bot. **28:** 79. 1922.

Rich woods. Circumneutral. East-central Mo., local: St. Louis Co.

A typo differt petalis staminibusque luteis vel viridi-luteis.

This form appears identical with that described by Friesner. The *Trillium recurvatum* forma *luteum* described by Clute has the claws, the petals, and the stamens brownish-red, and therefore cannot be considered the same as the yellow-flowered form in Missouri in which the petals, including the claws, are throughout yellow or greenish-yellow as are the stamens.

This form is dedicated to Mr. W. F. Shay, Head of the Biology Department at Normandy High School, Missouri, who first called attention to it.

Collected at Monarch Hill, near Monarch, St. Louis Co., Mo., April 29, 1935, by *W. F. Shay* (Mo. Bot. Gard.).

Trillium Gleasoni Fernald, Rh. **34:** 21–22. 1932.

Trillium declinatum (Gray) Gleason, not Raf. (G), (B & B).

Rich rocky or alluvial woods. Circumneutral. Eastern and middle Mo.: Ralls, Boone, Callaway, Warren, St. Charles, St. Louis, Jefferson, Franklin, St. Francois, Perry, Scott, and Wayne counties.

Trillium ozarkanum Palmer & Steyermark, sp. nov.

Rocky or alluvial ground. Circumneutral to oxylophile. Southwestern Mo., local: Barry Co.

Planta rhizomate crasso elongato fere horizontale; caule purpureo vel interdum in parte superiore viridi, 1–3 dm. alto; foliis lanceolatis elliptico-oblongis vel oblongo-ovatis, firme membranaceis, apice obtusis basi late cuneatis vel subito in petiolum brevissimum contractis, 4–8.5 cm. longis, 1–2.5 cm. latis, manifeste quinque-nerviis; pedunculo erecto, 1.5–3 cm. longo; sepalis oblongo-linearibus vel oblongo-ovatis, 1.5–4 cm. longis, 0.5–1.6 cm. latis, quinque-nerviis (vel raro tri-nerviis), petalis plerumque longioribus; petalis oblongo-lanceolatis vel anguste ovatis, intus candidis ad roseis vel rubro-purpureis, extus plerumque magis coloratis vel interdum utrinque intense roseo-purpureis; filamentis 2.5–5 mm. longis; antheris oblongo-linearibus, 4.5–9 mm. longis; stigmatibus basi connatis apice reflexis; fructu ovoideo vel subgloboso, 0.8–1 cm. longo, 0.7–0.8 cm. lato.

Rootstock thickened and elongated; stems 1–3 dm. tall, dark purple below and sometimes green in upper portion; leaves forest-green to grass-green, firmly membranaceous, dull above, lustrous beneath, lanceolate or oblong-elliptic to oblong ovate, obtuse at apex, broadly cuneate at base, subsessile or abruptly contracted into very short petiolules, 4–8.5 (rarely 3.5) cm. long, 1–2.5 cm. broad; peduncle erect, 1.5–3 cm. long; sepals spreading, conspicuously veined with 5 (rarely 3) principal veins, linear-oblong to broadly oblong-ovate, obtuse or rounded at apex, 1.5–4 cm. long, 0.5–1.6 cm. broad, usually exceeding the petals; petals varying from pure white to pinkish or rose purple within, usually more deeply colored without, or sometimes rich rose purple on both sides, spreading or slightly recurved at tips, oblong-lanceolate to ovate, broadest near the base, obtuse to acute at apex, 1.6–3.4 cm. long, 0.5–1.8 cm. broad; stamens in

anthesis equalling or somewhat exceeding the stigmas, the filaments short, 2.5–5 mm. long, anthers straight, 4.5–9 mm. long; stigmas united at base, spreading and recurved at apex; ovary white or pale green; fruit ovoid to subglobose, 0.8–1 cm. long, 0.7–0.8 cm. broad.

Distribution: Cherty soil of low wooded slopes and along small draws in upland oak woods; western Ozark region, northwestern Arkansas, and southwestern Missouri.

This new species adds another to the numerous endemics of the Ozark region, several of which are confined to the northwestern portion. While closely related to *Trillium pusillum* Michx., of the Atlantic Coastal Plain, and to *Trillium texanum* Buckley, of eastern Texas, *Trillium ozarkanum* has several characters that mark it as distinct from either of these species. The leaves and sepals average much broader and have normally five instead of three principal veins, which stand out more prominently; the petals are also much longer and broader on the average, and the peduncles are distinctly longer. The habitat, in comparatively dry cherty soil on wooded slopes of deciduous upland woods, is quite different from that of the other two related species.

MISSOURI: in cherty soil along slopes of a draw in upland oak-chinquapin woods, 3 mi. south of Cassville, Barry Co., April 20, 1935, *J. A. Steyermark 18628* (Mo. Bot. Gard. Herb. TYPE); 5 mi. s. of Cassville, April 13, 1930, *C. Shoop*, (Shoop Herb. and Univ. Mo. Herb.); ARKANSAS: in woods, dry rocky chert soil, Boone Co., March 28, 1921, *J. T. Buchholz* (Mo. Bot. Gard. Herb. and Univ. Ark. Herb.); wooded slope in chert hills southwest of Elm Springs, Washington Co., June 1, 1923, *J. T. Buchholz* (Mo. Bot. Gard. Herb. and Univ. Ark. Herb.); in Boone chert, flinty limestone soil, Osage, April 20, May 10, 1922, *J. T. Buchholz* (Gray Herb); Withrow Springs, Madison Co., April 15, 1928, *Moore & Demaree 4803* (Mo. Bot. Gard. Herb.); same locality, May 10, 1924, *E. J. Palmer 24801* (Palmer Herb.).

Trillium nivale Riddell. Snowy Wake-Robin.

Rich and rocky woods along streams and moist shaded ledges. Circumneutral. Southern and central Mo.: Callaway and Texas counties. Rare and local.

Smilax herbacea L. Carrion-flower.

Rich alluvial woods and thickets. Circumneutral. General.

Smilax herbacea var. **pulverulenta** (Michx.) Gray.

Rich or rocky woods and thickets. Circumneutral. General, but scattered: Adair, Ralls, Pike, Jefferson, Shannon, Texas, Boone, Jackson, Greene, Lawrence, and Jasper counties.

Smilax herbacea var. **lasioneuron** (Hook.) A. DC.

Occasionally found with the typical form. Circumneutral. General but scattered: St. Louis, Jefferson, Shannon, Wright, Adair, Mercer, Jackson, Cass, Greene, and Jasper counties.

Smilax ecirrhata (Engelm.) Wats.

Rocky woods. Circumneutral. General but not common: Harrison, Gentry, Putnam, Schuyler, Clark, Macon, Shelby, St. Louis, Jefferson, Franklin, Phelps, Miller, Morgan, Boone, and Jasper counties.

Smilax rotundifolia L. var. **quadrangularis** (Muhl.) Wood. Cat-brier.

Moist alluvial grounds, woods, and thickets. Circumneutral to oxylophile. Southeastern Mo.: Madison, Bollinger, Mississippi, New Madrid, Dunklin, Butler, Ripley, and Oregon counties. Forms of *S. hispida* and *S. Bona-nox* have often been confused with this. The typical var. is probably not found in Mo.

Smilax hispida Muhl. Bristly Green-brier.

Woods, thickets, and banks of streams. Circumneutral. General.

Smilax Bona-nox L. Stretch-berry, Green-brier.

Rocky open woods, thickets, and fields. Oxylophile to circumneutral. Southern and east-central Mo.: St. Louis, Jefferson, Perry, Cape Girardeau, Mississippi, New Madrid, Madison, Bollinger, Iron, Wayne, Butler, Dunklin, Ripley, Oregon, Howell, Carter, Shannon, Reynolds, Dent, Phelps, Texas, Douglas, Wright, Webster, Ozark, Taney, Stone, Barry, Jasper, Newton, and McDonald counties.

Smilax glauca Walt. var. **genuina** Blake, Rh. **20**: 79. 1918.

Rocky open woods and wet open ground. Oxylophile. Southeastern Mo.: Madison, Carter, and Dunklin counties. Less common than the next following.

Smilax glauca var. **leurophylla** Blake, Rh. **20**: 80. 1918.

Rocky open woods, fields, and wet open ground. Oxylophile. Southeastern Mo.: Ste. Genevieve, St. Francois, Cape Girardeau, Bollinger, Madison, Iron, Wayne, Carter, Stoddard, Scott, Mississippi, New Madrid, Dunklin, Butler, Ripley, and Oregon counties.

Fam. DIOSCOREACEAE

Dioscorea quaternata (Walt.) Gmel. See Rh. **36**: 345. 1934.

Dioscorea glauca Muhl. (S).

Rich woods and thickets, rocky ground at base of bluffs, and talus slopes. Circumneutral. Southern Mo.: Jefferson, Madison, Bollinger, Ste. Genevieve, Wayne, Carter, Iron, Shannon, Crawford, Ripley, Oregon, Texas, Taney, and Ozark counties.

Dioscorea villosa L. See Rh. **20**: 48. 1918. Wild Yam.

Rich rocky woods and thickets. Circumneutral. General.

Dioscorea villosa var. **glabrifolia** (Bartlett) Blake, Rh. **20**: 49. 1918.

Occasionally found with the typical form. Scattered: Perry, Daviess, Macon, Boone, Jackson, Cass, Henry, Jasper, Newton, McDonald, and Stone counties.

Fam. AMARYLLIDACEAE

NARCISSUS POETICUS L. Poet's Narcissus.

Occasionally escaped from gardens into abandoned fields, meadows, and waste places.

Hymenocallis occidentalis (LeConte) Kunth. Spider-lily.

Swamps and low wet woods. Circumneutral. Southeastern Mo.: Pemiscot, Dunklin, Butler, and Ripley counties.

Agave virginica L. False Aloe.

Rocky open woods and glades. Calciphile. Southern and east-central Mo.,

south of a line drawn from St. Louis to the southwestern corner of the state: St. Louis, Jefferson, Franklin, Ste. Genevieve, Perry, Washington, Madison, Bollinger, Dunklin, Ripley, Carter, Oregon, Dent, Howell, Shannon, Texas, Pulaski, Douglas, Ozark, Taney, Stone, Wright, Greene, Barry, and McDonald counties.

Agave virginica f. **tigrina** (Engelm.) Palmer & Steyermark, comb. nov.

Agave virginica var. *tigrina* Engelm. Trans. Acad. Sci. St. Louis **3**: 302. 1876.

Occasionally occurring with the species in Missouri.

Hypoxis hirsuta (L.) Coville. Yellow Star-grass.

Dry open woods, thickets, glades, and rocky prairies. Oxylophile. General.

Hypoxis hirsuta var. **leptocarpa** (Engelm. & Gray) Brackett. Rh. **25**: 127. 1923

Moist sandy ground. Oxylophile. Local: Ste. Genevieve Co.

Fam. Iridaceae

Iris virginica L. Wild Blue Flag.

Iris Shrevei Small (S).

Iris caroliniana Wats. (G), in part.

Iris versicolor of auth., not L. (G), (B & B), in part.

Swamps and borders of ponds and sloughs. Circumneutral. General.

Iris fulva Ker. Red Iris.

Swampy woods, and borders of sloughs and bayous. Circumneutral. Southeastern Mo.: Perry, Scott, Dunklin, Butler, and Ripley counties.

Iris foliosa Mack. & Bush.

Sloughs, wet meadows, and borders of low woods. Circumneutral. Central Mo., along the larger rivers: Marion, St. Louis, Jefferson, Washington, Boone, and Jackson counties.

Iris pseudacorus L. Yellow Flag.

Cultivated in old gardens and occasionally escaped to fields and roadsides.

Iris pallida Lam. Blue Flag, Fleur-de-lis.

Cultivated and escaping to roadsides and waste ground.

Iris cristata Ait. Dwarf Wild Iris.

Rocky woods, sandy banks and ledges along bluffs. Oxylophile to circumneutral. Usually growing on sandstone, chert, or granitic rocks, rarely on limestone. Southeastern Mo.: Reynolds, Wayne, Carter, Ripley, Shannon, and Oregon counties.

Iris pumila L.

Escaped from cultivation. Fields, meadows, and wet glades. Scattered: Washington and Boone counties.

Nemastylis acuta (Bart.) Herb.

Limestone glades and rocky prairies. Calciphile. Central and southern Mo., scattered and rare: Franklin, Washington, Ste. Genevieve, Iron, Wright, Taney, and Cass counties.

Belamcanda chinensis (L.) DC. Blackberry Lily.

Cultivated in old gardens, and escaped and well established in thickets, glades, and rocky open woods. Circumneutral. General.

Sisyrinchium albidum Raf.

Meadows and open woods. Circumneutral. Eastern and middle Mo.: Randolph, St. Louis, Jefferson, Franklin, Washington, Ste. Genevieve, and Iron counties. This and other species of *Sisyrinchium* have sometimes been confused with *S. angustifolium* which is not known in Mo.

Sisyrinchium flaviflorum Bicknell.

Post-oak woods. Oxylophile. Western Mo., local: Jackson Co.

Sisyrinchium campestre Bicknell. Blue-eyed Grass.

Prairies, meadows, glades, and open rocky woods. Circumneutral. General.

Sisyrinchium campestre var. **kansanum** Bicknell.

Rocky prairies, glades, and open woods. Circumneutral. Southwestern Mo.: Jasper, Newton, and Barry counties.

Sisyrinchium graminoides Bicknell.

Sisyrinchium gramineum Curtis, not Lam. (G).

Rocky open woods, meadows, and prairies. Circumneutral. General.

Fam. Marantaceae

Thalia dealbata Roscoe.

Swamps. Circumneutral. Southeastern Mo., local: Butler Co.

Fam. Orchidaceae

Cypripedium parviflorum Salisb. Yellow Lady's Slipper.

Rich rocky ground, and moist shaded hillsides. Circumneutral. General but scattered and commonest in the western half of the state: Boone, Callaway, Crawford, Phelps, Shannon, Nodaway, Grundy, Saline, Jackson, Johnson, Greene, Stone, Lawrence, Jasper, Newton, and McDonald counties.

Cypripedium parviflorum var. **pubescens** (Willd.) Knight. Large Yellow Lady's Slipper.

Moist alluvial banks and rich rocky woods. Circumneutral. General but scattered and commonest in eastern and northern Mo.: Warren, Pike, St. Louis, Jefferson, Franklin, Washington, Crawford, Dent, Wayne, Carter, Ripley, Schuyler, Adair, Putnam, Mercer, Harrison, Jackson, and Greene counties.

Cypripedium candidum Muhl. Small White Lady's Slipper.

Rich rocky woods at the base of bluffs. Circumneutral. Scattered and rare: St. Louis, Shannon, Atchison, and Andrew counties.

Cypripedium Reginae Walt. Showy Lady's Slipper.

Cypripedium hirsutum of some Am. auth., not Mill. (G).

Rich rocky or moist woods and bluffs. Calciphile to circumneutral. Scattered: Putnam, Iron, Shannon, Texas, and Ozark counties.

Orchis spectabilis L. Showy Orchis.

Rich moist woods. Circumneutral. General but uncommon: St. Louis, Jefferson, Franklin, Bollinger, Iron, Reynolds, Dunklin, Schuyler, Adair, Sullivan, Warren, Boone, Ray, Clay, Platte, Jackson, Greene, and Taney counties.

Habenaria flava (L.) Gray var. **virescens** (Muhl.) Fernald. See Rh. **23**: 148. 1921. Yellow Orchis.

Wet woods, borders of swamps and bogs. Circumneutral to oxylophile. General but scattered and mostly in eastern and northern Mo.: Schuyler, Livingston, St. Louis, Jefferson, Iron, Butler, Dunklin, Shannon, and Howell counties.

Habenaria clavellata (Michx.) Spreng. Green Wood Orchis.

Borders of swamps and bayous. Oxylophile. Southeastern Mo., local: Dunklin Co.

Habenaria ciliaris (L.) R. Br. Yellow Fringed Orchis.

Pine woods and moist wooded slopes. Oxylophile. Southeastern Mo.: Iron and Ripley counties.

Habenaria lacera (Michx.) R. Br. Ragged Orchis.

Moist meadows and prairies. Circumneutral. Scattered: Audrain, Boone, Callaway, St. Louis, and Shannon counties, and also reported from Greene Co.

Habenaria peramoena Gray. Purple Fringed Orchis.

Low borders of lakes, wet rocky ground about springs, and low rich woods along streams. Oxylophile. Southeastern Mo.: Iron, Carter, Bollinger, Ripley, Butler, and Dunklin counties.

Habenaria leucophaea (Nutt.) Gray. White-flowered Prairie Orchis.

Prairies and meadows. Circumneutral. Scattered: Ralls, St. Louis, Jefferson, Madison, Clinton, Jackson, Vernon, and Greene counties.

Pogonia trianthophora (Sw.) BSP. Nodding Log Orchis.

Rich low woods. Circumneutral. Central and southern Mo.: Boone, St. Louis, Jefferson, Franklin, Bollinger, Mississippi, Dunklin, Butler, Shannon, Jackson, and Jasper counties.

Isotria affinis (Aust.) Rydb.

Pogonia affinis Aust. (G).

Wooded limestone hills. Calciphile. Southeastern Mo., local: Bollinger Co.

Calopogon pulchellus (Sw.) R. Br. Grass Pink.

Moist rich woods. Circumneutral. Scattered and rare: Shannon and Greene counties.

Epipactis latifolia (L.) All. Helleborine.

Serapias Helleborine of auth., not L. (G), (B & B).

Wet gravelly soil at base of bluff. Oxylophile. Southwestern Mo., local: Jasper Co.

Spiranthes Beckii Lindl. Little Ladies' Tresses.

Prairies, open rocky woods, and dry meadows. Oxylophile to circumneutral. East-central and southern Mo.: St. Louis, Ste. Genevieve, Scott, Franklin, Gasconade, Crawford, Dent, Shannon, Oregon, Texas, Greene, and Jasper counties.

Spiranthes gracilis (Bigel.) Beck. Slender Ladies' Tresses.

Dry open woods. Oxylophile. Central and southern Mo.: St. Louis, Jefferson, Franklin, Ste. Genevieve, Iron, Reynolds, Dent, Shannon, Oregon, Texas, Randolph, Boone, Jackson, Dade, Greene, Taney, Stone, Barry, Jasper, Newton, and McDonald counties.

Spiranthes vernalis Engelm. & Gray.

Prairies and dry meadows. Circumneutral. Central and southern Mo., scattered: St. Louis, Jefferson, Jackson, Barton, and Jasper counties.

Spiranthes lucida (H. H. Eaton) Ames.

Moist sandstone ledges along creek and springy ground. Oxylophile. Southeastern Mo.: Texas and Shannon counties. This species blooms during May.

Spiranthes ovalis Lindl.

Rich or low wet woods. Circumneutral. Central and southern Mo., rare and scattered: St. Louis, Mississippi, and Jackson counties.

Spiranthes cernua (L.) Richard. Nodding Ladies' Tresses.

Prairies, meadows, and moist places in glades. Circumneutral. General.

Spiranthes cernua var. **ochroleuca** (Rydb.) Ames.

Prairies and glades. Circumneutral. Central and southern Mo.: Boone, Shannon, Taney, Stone, Barry, Jasper, and Newton counties.

Goodyera pubescens (Willd.) R. Br. Downy Rattlesnake Plantain.

Epipactis pubescens (Willd.) A. A. Eaton (G).

Peramium pubescens (Willd.) MacM. (B & B).

Moist, rich, sandy soil, in wooded ravines. Oxylophile. Southeastern Mo., local: Ste. Genevieve Co.

Corallorrhiza Wisteriana Conrad. Coral-root.

Rich or rocky open woods. Circumneutral. Central and southern Mo.: St. Louis, Jefferson, Franklin, St. Francois, Madison, Boone, Jackson, Greene, Lawrence, and Jasper counties.

Corallorrhiza odontorhiza Nutt. Small Coral-root.

Moist rich woods. Circumneutral. East-central and southern Mo.: St. Louis, Jefferson, Franklin, Ste. Genevieve, Dunklin, Shannon, and Jasper counties.

Corallorrhiza trifida Chatelain. Yellow Coral-root.

Moist rich hillsides. Circumneutral. Southwestern Mo., rare and local: Lawrence Co.

Malaxis unifolia Michx. See Rh. **28**: 176. 1926. Adder's-mouth.

Microstylis unifolia (Michx.) BSP. (G).

Dry rich woods. Oxylophile. East-central and southern Mo.: St. Louis, Jefferson, Franklin, Ste. Genevieve, Shannon, Howell, and Greene counties.

Liparis liliifolia (L.) Richard. Large Twayblade.

Dry open woods and hillsides. Oxylophile to circumneutral. General, but uncommon and apparently absent from much of western Mo.: Mercer, Sullivan, Schuyler, Clark, Lewis, Boone, Callaway, St. Louis, Jefferson, Franklin, Ste. Genevieve, Cape Girardeau, Dunklin, Phelps, Reynolds, Shannon, Texas, Howell, Douglas, Ozark, Greene, Jasper, and McDonald counties.

Aplectrum hyemale (Muhl.) Torr. Putty-root, Adam-and-Eve.

Rich or alluvial woods. Circumneutral. Central and southern Mo.: Boone, Callaway, Warren, St. Charles, St. Louis, Jefferson, Franklin, Ste. Genevieve, Washington, Madison, Iron, Wayne, Clay, Jackson, and Greene counties.

Hexalectris spicata (Walt.) Barnh. See Rh. **17**: 136. 1915. Crested Coral-root.

Hexalectris aphylla (Nutt.) Raf. (G), (B & B).

Rich rocky woods. Oxylophile to circumneutral. Eastern Mo. south of the Missouri River, rare: St. Louis, Jefferson, Franklin, Dunklin, Phelps, Pulaski, and Texas counties.

Fam. Piperaceae

Saururus cernuus L. Lizard's-tail.

Swampy woods and borders of sloughs and sluggish streams. Circumneutral. Central and southern Mo.: Gasconade, Franklin, St. Louis, Jefferson, Bollinger, Mississippi, New Madrid, Pemiscot, Dunklin, Butler, Ripley, Carter, Wayne, Iron, Oregon, Reynolds, Shannon, Dent, Crawford, Texas, Phelps, Maries, Osage, Camden, Pulaski, Laclede, Dallas, Greene, Barry, Barton, Jasper, Newton, and McDonald counties.

Fam. Salicaceae

Salix nigra Marsh. Black Willow.

Low woods and borders of streams, sloughs, and ponds. Circumneutral. General.

Salix longipes Shuttlw. var. **Wardii** (Bebb) Schneider, Bot. Gaz. **65**: 22. 1918. Ward's Willow.

Salix Wardii Bebb (G), (B & B).

Rocky banks of streams. Oxylophile to circumneutral. Southern and central Mo. and locally northward along Missouri and Mississippi rivers.

Salix amygdaloides Anders. Peach-leaved Willow.

Low woods and alluvial banks of streams, especially along the larger rivers. Circumneutral. Northern, central, and eastern Mo., absent from most of the Ozark region.

Salix alba L. White Willow.

Moist ground along banks of streams and ponds. Circumneutral. Often planted and escaping. General but scattered.

Salix alba var. vitellina (L.) Koch.

In similar situations to the typical form and more common in cultivation and as an escape.

Salix alba var. calva G. F. W. Mey.

Salix coerulea (Sm.) K. Koch.

Occasionally found as an escape, in similar situations to the last.

Salix fragilis L. Crack Willow, Brittle Willow.

Low grounds along streams. Scattered: St. Louis, Atchison, and Dekalb counties.

Salix interior Rowlee. Sand-bar Willow.

Salix longifolia Muhl., not Lam. (G).

Wet alluvial banks and sand-bars along streams and ponds. Circumneutral. General.

Salix interior var. **Wheeleri** Rowlee, Bull. Torr. Bot. Club **27**: 253, *pl. 9*. 1900.

Alluvial banks and sand bars along streams. Circumneutral. Scattered: Clark, Monroe, Clay, and Jackson counties.

SALIX BABYLONICA L. Weeping Willow.

Escaped from cultivation in Jackson Co.

Salix cordata Muhl. Heart-leaved Willow.

Wet open ground along streams and about springs. Oxylophile to circumneutral. General but not common: Clark, Lewis, Knox, St. Louis, Ste. Genevieve, Perry, Washington, Iron, Madison, Wayne, Carter, Gasconade, Shannon, Texas, Howell, Wright, Douglas, Schuyler, Adair, Putnam, Sullivan, Linn, Saline, Boone, Cooper, Benton, Polk, Greene, Taney, Mercer, Gentry, Livingston, Harrison, Worth, Atchison, Jackson, Bates, Vernon, Jasper, and Lawrence counties.

Salix cordata var. **angustata** Anders.

Moist ground along streams. Oxylophile to circumneutral. Scattered, mainly in northern Mo.: Clark, Knox, Schuyler, Adair, Wayne, Sullivan, Grundy, Harrison, Nodaway, Saline, and Jackson counties.

Salix missouriensis Bebb.

Salix cordata var. *myricoides* (Muhl.) Carey (G), in part.

Low wet ground, mainly along the larger rivers. Circumneutral. Northern, central, and eastern Mo.: Clark, Marion, Boone, Warren, St. Louis, Cape Girardeau, Worth, Atchison, Holt, Clay, and Jackson counties.

Salix discolor Muhl. Pussy Willow.

Low ground along streams. Circumneutral. Northeastern Mo., local: Clark Co.

Salix petiolaris Sm.

Low wet ground along streams. Circumneutral. Northeastern Mo.: Marion and Pike counties.

Salix humilis Marsh. Prairie Willow.

Prairies, thickets, and open woods. Oxylophile to circumneutral. General.

Salix humilis var. **rigidiuscula** Anders.

In similar situations to the preceding. Circumneutral. Scattered: Shannon, Atchison, Holt, and Jackson counties.

Salix tristis Ait. Dwarf Gray Willow, Dwarf Pussy Willow.

Dry prairies and rocky or gravelly banks. Circumneutral to oxylophile. Scattered: Pike, Dent, Phelps, Putnam, Sullivan, Harrison, and Jackson counties.

Salix sericea Marsh. Silky Willow.

Along small rocky streams and in boggy ground about springs. Oxylophile. Eastern Ozark region: St. Louis, Washington, St. Francois, Perry, Cape Girardeau, Bollinger, Madison, Iron, Carter, and Texas counties.

SALIX PURPUREA L. Purple Willow.

Moist or wet ground. Cultivated and occasionally escaped. Pike Co.

Salix myricoides Muhl.

A hybrid between *Salix cordata* and *S. sericea*. Local: St. Louis Co.

Salix humilis × missouriensis.

Wet ground along streams. Jackson Co.

Salix longipes var. **Wardii × sericea.**

Wet rocky ground. St. Francois Co.

Salix cordata × longipes var. **Wardii.**

Along rocky streams. Taney Co.

Salix cordata × nigra.

Low open ground. Atchison Co.

Salix cordata × humilis.

Low ground along small streams. Putnam Co.

Salix longipes var. **Wardii × nigra.**

Along rocky streams. St. Louis, St. Francois, Iron, Dunklin, and Jasper counties.

Salix amygdaloides × nigra.

Low ground along river. St. Louis Co.

Populus deltoides Marsh. Cottonwood.

Populus balsamifera of recent auth., and perhaps of L., in part.

Moist or wet, usually alluvial, ground along streams. Circumneutral. General and probably in every county.

Populus deltoides f. **pilosa** (Sarg.) Sudw.

Populus balsamifera var. *pilosa* Sarg.

Swamps and low woods. Circumneutral. Southeastern Mo., local: Dunklin Co.

Populus canadensis Moench. var. Eugenei (Simon-Louis) Schelle. Carolina Poplar.

Frequently planted under the name of Carolina Poplar and occasionally escaping in thickets and along streams. Jasper Co.

Populus tremuloides Michx. Quaking Aspen.

Thickets and borders of upland woods. Circumneutral to oxylophile. Northeastern Mo.: Clark and Adair counties, and also reported from Sullivan Co.

Populus grandidentata Michx. Large-toothed Aspen.

In similar situations to the last. Local: Clark Co. Probably introduced or escaped from cultivation.

Populus alba L. Silver Poplar.

Commonly planted and escaping freely into thickets and along fence rows and borders of small streams. Scattered: Ralls, Pike, St. Louis, Franklin, Reynolds, Dent, Boone, Mercer, Vernon, and Jasper counties.

Populus heterophylla L. Downy Poplar, Swamp Cottonwood.

Swamps and low wet woods. Circumneutral. Southeastern Mo.: Cape Girardeau, Bollinger, Scott, Mississippi, New Madrid, Pemiscot, Dunklin, Stoddard, Wayne, Butler, and Ripley counties.

Fam. Leitneriaceae

Leitneria floridana Chapm. Cork Wood.

Deep swamps. Circumneutral. Southeastern Mo.: Dunklin, Butler, and Ripley counties.

Fam. JUGLANDACEAE

Juglans nigra L. Black Walnut.

Rich or open woods, along streams. Circumneutral to calciphile. General and probably found in every county.

Juglans cinerea L. Butternut.

Rich woods and along bluffs. Circumneutral. General except in extreme western part of state, but nowhere common: Clark, Schuyler, Sullivan, Adair, Lewis, Macon, Shelby, Marion, Monroe, Ralls, Pike, Lincoln, Audrain, St. Louis, Jefferson, Franklin, St. Francois, Iron, Madison, Bollinger, Cape Girardeau, Scott, Mississippi, Stoddard, Dunklin, Butler, Wayne, Carter, Ripley, Reynolds, Shannon, Oregon, Texas, Crawford, Dent, Phelps, Pulaski, Maries, Boone, Howard, Cooper, Saline, Lafayette, Henry, Morgan, Miller, Camden, Benton, Hickory, Dallas, Laclede, Wright, Douglas, Ozark, Taney, Greene, and Stone counties.

Carya Pecan (Marsh.) Engl. & Graebn. Pecan.

Carya illinoensis (Wang.) K. Koch (G).

Hicoria Pecan (Marsh.) Britton (B & B).

Low woods and alluvial ground along streams. Circumneutral. General but most frequent along the larger rivers: Clark, Lewis, Pike, Lincoln, Montgomery, St. Charles, St. Louis, Jefferson, Ste. Genevieve, Perry, Cape Girardeau, Bollinger, Mississippi, Pemiscot, Dunklin, Ripley, Ozark, Gasconade, Maries, Cole, Morgan, Cooper, Howard, Carroll, Adair, Livingston, Platte, Clay, Jackson, Henry, Bates, Vernon, Jasper, and McDonald counties.

Carya aquatica (Michx. f.) Nutt. Bitter Pecan, Swamp Hickory.

Swamps and low wet woods. Circumneutral. Southeastern Mo.: Bollinger, Scott, Dunklin, and Butler counties.

Carya cordiformis (Wang.) K. Koch. Pignut Hickory, Bitternut Hickory.

Hicoria cordiformis (Wang.) Britton (B & B).

Woods, usually in moist ground along streams. Circumneutral. General.

Carya cordiformis var. **latifolia** Sarg. Trees & Shrubs **2**: 206. 1913.

In similar situations to the typical form. Circumneutral. General but not common: Clark, Marion, Shelby, Shannon, Mercer, Harrison, Nodaway, Jackson, Jasper, and McDonald counties.

Carya ovata (Mill.) K. Koch. Shag-bark or Shell-bark Hickory.

Hicoria ovata (Mill.) Britton (B & B).

Woods, limestone hills, and borders of streams. Calciphile. General and found in nearly all if not all counties of the states, though uncommon in some parts of the Ozark region.

Carya ovata var. **ellipsoidalis** Sarg. Bot. Gaz. **66**: 235. 1918.

Occasionally found with the typical form. Scattered: Marion, Ralls, and Johnson counties.

Carya laciniosa (Michx. f.) Loud. Kingnut, Big Shell-bark Hickory.

Low alluvial woods along streams. Circumneutral. General except in most of the Ozark region: Clark, Scotland, Schuyler, Putnam, Mercer, Adair, Livingston, Linn, Macon, Shelby, Chariton, Monroe, Audrain, Lincoln, St. Louis, Jef-

ferson, Cape Girardeau, Bollinger, Madison, Scott, Mississippi, Pemiscot, Dunklin, Stoddard, Wayne, Butler, Ripley, Maries, Cole, Moniteau, Boone, Gentry, Atchison, Jackson, Johnson, St. Clair, Hickory, Cedar, Lawrence, Vernon, Barton, and Jasper counties.

Carya tomentosa Nutt. Mocker Nut, White Hickory.
Carya alba (L.) K. Koch, not Nutt. (G), (B & B).
Dry upland woods. Oxylophile. Usually on sandstone, chert, or igneous rocks. General.

Carya tomentosa f. **ficoides** (Sarg.) Palmer & Steyermark, comb. nov.
Carya alba var. *ficoides* Sarg. Trees & Shrubs **2**: 206. 1913.
Dry upland woods. Oxylophile. Southwestern Mo.: Jasper Co.

Carya tomentosa f. **ovoidea** (Sarg.) Palmer & Steyermark, comb. now.
Carya alba var. *ovoidea* Sarg. Bot. Gaz. **66**: 238. 1918.
Rocky upland woods. Oxylophile. Southwestern Mo.: McDonald Co.

Carya tomentosa var. **subcoreacea** (Sarg.) Palmer & Steyermark, comb. nov.
Carya alba var. *subcoreacea* Sarg. Trees & Shrubs **2**: 207. 1913.
Dry upland woods. Oxylophile. Southern Mo.: Dunklin, Shannon, Texas, Barry, and McDonald counties.

Carya Buckleyi Durand var. **arkansana** Sarg. Bot. Gaz. **66**: 249. 1918.
Dry and rocky upland woods. Oxylophile. Eastern, central, and southern Mo.: Marion, Ralls, Pike, St. Louis, Jefferson, Ste. Genevieve, Perry, Dunklin, Butler, Wayne, Carter, Ripley, Oregon, Howell, Shannon, Texas, Iron, Dent, Washington, Crawford, Phelps, Pulaski, Maries, Gasconade, Boone, Saline, Moniteau, Pettis, Jackson, Henry, Benton, Camden, Hickory, Dallas, Polk, Cedar, Vernon, Dade, Douglas, Ozark, Taney, Stone, Barry, Jasper, Newton, and McDonald counties.

Carya Buckleyi var. **villosa** Sarg. Bot. Gaz. **66**: 251. 1918.
Carya glabra var. *villosa* (Sarg.) Robinson (G).
Hicoria villosa (Sarg.) Ashe (B & B).
Dry and rocky upland woods. Oxylophile. Eastern, central, and southern Mo.: Marion, Ralls, St. Louis, Ste. Genevieve, Iron, Bollinger, Dunklin, Howell, Phelps, Pettis, Jackson, Jasper, and McDonald counties.

Carya glabra (Mill.) Spach.
Upland woods. Oxylophile. Southeastern Mo.: Cape Girardeau and Dunklin counties.

Carya ovalis (Wang.) Sarg.
Dry or rocky upland woods. Oxylophile. Southeastern Mo.: Ste. Genevieve and Dunklin counties.

Carya ovalis var. **obovalis** Sarg. Trees & Shrubs **2**: 209. 1913.
Carya glabra (Mill.) Spach, in part (G).
Hicoria glabra (Mill.) Britton, in part (B & B).
Dry and rocky upland woods. Oxylophile. Eastern and southern Mo.: Marion, Ralls, Pike, St. Louis, Washington, Iron, Madison, Cape Girardeau, Mississippi, Dunklin, Butler, Wayne, Shannon, Ozark, Taney, Stone, Greene, Benton, Hickory, St. Clair, Jasper, and Newton counties.

Carya ovalis var. **odorata** Sarg. Trees & Shrubs **2**: 208. 1913.

Carya microcarpa Nutt., in part (G).

Hicoria microcarpa (Nutt.) Britton, in part (B & B).

Rocky upland woods. Oxylophile. Southeastern Mo., in the Iron Mountain sub-region: Iron and Madison counties.

Carya ovalis var. **obcordata** Sarg. Trees & Shrubs **2**: 208. 1913.

Carya microcarpa Nutt., in part (G).

Hicoria microcarpa (Nutt.) Britton, in part (B & B).

Dry and rocky uplands. Oxylophile. Eastern, central, and southern Mo.: Marion, St. Louis, Iron, Madison, Bollinger, Dunklin, Ripley, Shannon, Boone, Howard, Cooper, Saline, Pettis, Johnson, Douglas, Ozark, Taney, Stone, Cedar, Vernon, Barton, Jasper, and McDonald counties.

Carya ovalis var. **obcordata** f. **vestita** Sarg. Bot. Gaz. **66**: 246. 1918.

Dry upland woods. Oxylophile. Scattered: Montgomery, Gasconade, and Henry counties.

Fam. Betulaceae

Corylus americana Walt. Hazelnut.

Thickets and borders of woods. Circumneutral. General and probably in every county of the state.

Corylus americana f. **missouriensis** (A. DC.) Fernald, Rh. **34**: 96. 1932.

Occasionally found with the typical form. Scattered.

Corylus americana var. **indehiscens** Palmer & Steyermark, var. nov.

Thickets, fence rows, and borders of woods. Circumneutral. Scattered: Jackson, Johnson, Jasper, and Newton counties, and perhaps more widely distributed.

A typo differt involucro fructus indehiscente vel dehiscente ad unum marginem.

Differs from the typical form in having the involucres of the fruit completely united on one side and usually partly united, towards the base, on the other side. North Carolina to Missouri and Arkansas. It has sometimes been confused with *C. cornuta* Marsh. *(C. rostrata* Ait.), which is rare in Missouri and which seems to be confined to the southeastern counties.

North Carolina: Sept. 19, 1897, *Biltmore Herb. 1244b;* Missouri: Greenwood, Jackson Co., Sept. 5, 1924, *B. F. Bush 10332* (Herb. Arn. Arb. type); same locality and date *E. J. Palmer 26035* (Herb. Arn. Arb.); Arkansas: Martinsville, Faulkner Co., Oct. 13, 1924, *E. J. Palmer 26537* (Herb. Arn. Arb.); Hot Springs, Garland Co., Oct. 11, 1925, *E. J. Palmer 29160* (Herb. Arn. Arb.).

Corylus cornuta Marsh. Beaked Hazelnut.

Corylus rostrata Ait. (G), (B & B).

Thickets and open woods. Circumneutral to oxylophile. Southeastern Mo.: Butler Co.

Ostrya virginiana (Mill.) K. Koch. Hop Hornbeam.

Borders of upland woods and along rocky bluffs and hillsides. Circumneutral to calciphile. General and probably in every county.

Ostrya virginiana var. **glandulosa** (Spach) Sarg. Bot. Gaz. **67**: 216. 1919.

In similar situations to the preceding. Known in Clark, Jackson, and Jasper counties, and probably more widely distributed, though uncommon.

Carpinus caroliniana Walt. Ironwood, Blue Beech.

Along streams and bluffs, and in low woods. Circumneutral. Eastern, central, and southern Mo.; apparently absent from most of the northern and western counties: Clark, Lewis, Ralls, Pike, Lincoln, Warren, St. Charles, St. Louis, Jefferson, Washington, St. Francois, Perry, Cape Girardeau, Bollinger, Madison, Iron, Reynolds, Wayne, Scott, Mississippi, Pemiscot, Dunklin, Stoddard, Butler, Ripley, Carter, Dent, Shannon, Oregon, Howell, Texas, Pulaski, Phelps, Callaway, Boone, Howard, Carroll, Saline, Buchanan, Cole, Miller, Morgan, Camden, Benton, Hickory, Douglas, Ozark, Taney, Stone, Barry, and McDonald counties.

Betula nigra L. River Birch.

Banks of rivers and creeks. Circumneutral. General but apparently absent from parts of the Ozark region and some of the northwestern counties.

Alnus rugosa (Du Roi) Spreng. Smooth Alder.

Banks of streams, and about springs and bogs. Oxylophile. Eastern, central, and southern Mo.: Lewis, Marion, Pike, Lincoln, Warren, St. Louis, Jefferson, Franklin, Crawford, Washington, St. Francois, Ste. Genevieve, Perry, Bollinger, Madison, Iron, Reynolds, Wayne, Stoddard, Ripley, Carter, Oregon, Howell, Shannon, Texas, Dent, Pulaski, Miller, Cole, Boone, Benton, St. Clair, Cedar, Douglas, Ozark, Taney, and Newton counties.

Fam. FAGACEAE

Fagus grandifolia Ehrh. Beech.

Woods, low hills, and along streams. Circumneutral. Southeastern Mo.: Cape Girardeau and Stoddard counties.

Fagus grandifolia var. **caroliniana** (Loud.) Fernald & Rehder.

In similar situations to the preceding and more common. Southeastern Mo.: Perry, Cape Girardeau, Bollinger, Scott, Stoddard, Dunklin, and Butler counties.

Castanea ozarkensis Ashe, Bull. Torr. Bot. Club **50**: 360. 1923. Chinquapin.

Castanea pumila of auth. in part, not Mill. (G), (B & B).

Rocky woods. Oxylophile. Southern Mo.: Howell, Barry, and McDonald counties.

Quercus alba L. White Oak.

Woods, chiefly on dry uplands. Circumneutral. General and probably in every county.

Quercus alba f. **latiloba** (Sarg.) Palmer & Steyermark, comb. nov.

Quercus alba var. *latiloba* Sarg.

In similar situations to the preceding and more common in some sections. A complete series of gradations are found between the two forms, and it scarcely seems distinct enough to be regarded as a variety.

Quercus stellata Wang. Post Oak.

Upland woods and along small streams. Oxylophile to circumneutral. General and probably in every county.

Quercus lyrata Walt. Overcup Oak.

Low or swampy woods. Circumneutral. East-central and southeastern Mo.: St. Louis, Jefferson, Cape Girardeau, Bollinger, Scott, Mississippi, New Madrid, Pemiscot, Dunklin, Stoddard, Butler, Wayne, and Ripley counties.

Quercus macrocarpa Michx. Bur Oak.

Low woods, chiefly in alluvial soil along streams. Circumneutral to calciphile. General.

Quercus macrocarpa var. **olivaeformis** (Michx f.) Gray.

Loess hills along the Missouri River. Northwestern Mo.: Atchison Co.

Quercus bicolor Willd. Swamp White Oak.

Low hills and alluvial ground along streams. Circumneutral. Northern, eastern, and central Mo., commonest north of the Missouri River and absent from most of the Ozark region.

Quercus Prinus L. See Rh. 17: 40. 1915. Cow Oak, Basket Oak.

Quercus Michauxii Nutt. (G), (B & B).

Low woods along streams. Circumneutral. Southeastern Mo.: Iron, Madison, Bollinger, Cape Girardeau, Scott, Mississippi, Stoddard, Dunklin, Butler, and Ripley counties.

Quercus Muhlenbergii Engelm. Chinquapin Oak, Yellow Oak.

Upland woods, glades, and along bluffs. Calciphile to circumneutral. Most frequent in limestone areas, but also found sometimes on sandstone or igneous rocks. General and probably in every county.

Quercus Muhlenbergii f. **Alexanderi** (Britton) Trelease.

Quercus Alexanderi Britton.

In similar situations to the preceding into which it passes by gradations. General but scattered.

Quercus prinoides Willd. Shin Oak, Scrub Oak.

Borders of woods, rocky bluffs, and glades. Calciphile. Central, southern, and western Mo., mostly in the western part: St. Louis, Shannon, Howell, Mercer, Harrison, Daviess, Caldwell, Worth, Gentry, Nodaway, Atchison, Holt, Andrew, Clinton, Jackson, Cass, Johnson, St. Clair, Vernon, Polk, Dade, Greene, and Stone counties.

Quercus falcata Michx. Spanish Oak, Southern Red Oak.

Quercus rubra L., in part, not of most recent auth.

Quercus triloba Michx. (B & B), in part.

Woods, both alluvial and rocky ground. Oxylophile to circumneutral. Southern Mo.: Perry, Cape Girardeau, Bollinger, Scott, Mississippi, New Madrid, Pemiscot, Dunklin, Stoddard, Butler, Wayne, Carter, Oregon, Ripley, Howell, Ozark, Stone, and Barry counties.

Quercus falcata f. **triloba** (Michx.) Palmer & Steyermark, comb. nov.

Quercus triloba Michx., in part (B & B).

Upland or lowland woods. Southeastern Mo.: Ripley and Dunklin counties.

Quercus falcata var. **pagodaefolia** Ell.

Quercus falcata Michx., in part (G).

Quercus pagodaefolia (Ell.) Ashe (B & B).

In similar situations to the last. Southeastern Mo.: Dunklin and Butler counties.

Quercus falcata var. **leucophylla** (Ashe) Palmer & Steyermark, comb. nov.

Quercus rubra var. *leucophylla* Ashe.

Low woods. Southeastern Mo.: New Madrid Co.

Quercus borealis Michx. f. Red Oak.

Quercus rubra var. *ambigua* (Michx. f.) Fernald (G).

Rarely occurring in our region with the following and common form. Jackson Co.

Quercus borealis var. **maxima** Ashe, Proc. Soc. Am. Foresters **11**: 90. 1916; and Rh. **18**: 48. 1916. Red Oak.

Quercus rubra of auth., not L. (G), (B & B).

Upland woods. Frequent along bluffs and steep hillsides in limestone regions, but also found on siliceous and igneous rocks. Circumneutral. General, and probably in every county.

Quercus palustris Muench. Pin Oak.

Low and swampy woods. Circumneutral. General, but absent or uncommon in much of the Ozark region, where it is sometimes found in sinks or shallow ponds and is known as Turkey Oak.

Quercus coccinea Muench. Scarlet Oak.

Upland woods. Oxylophile. Southeastern Mo., mostly in the eastern Ozarks: Ste. Genevieve, Washington, Crawford, Dent, Bollinger, Iron, Madison, Wayne, Butler, Dunklin, Ripley, Carter, Reynolds, Shannon, Oregon, Texas, and Howell counties.

Quercus coccinea var. **tuberculata** Sarg. Bot. Gaz. **65**: 426. 1918.

Occasionally found with the typical form. Southwestern Mo.: Butler Co.

Quercus ellipsoidalis E. J. Hill. Jack Oak, Yellow Oak.

Upland woods. Circumneutral. Northern Mo., local: Harrison Co.

Quercus Shumardii Buckley. Red Oak.

Low or upland woods. Circumneutral. Central and southern Mo.: Jefferson, Pemiscot, Dunklin, Ripley, Maries, Pulaski, Dent, Shannon, Howell, Montgomery, Ozark, Pettis, Jackson, Bates, Jasper, and McDonald counties.

Quercus Shumardii var. **Schneckii** (Britton) Sarg. Red Oak.

Quercus Schneckii Britton (B & B).

Quercus texana of auth., not Buckley (G).

Upland woods, bluffs, and alluvial ground along streams. Circumneutral to calciphile. Central and southern Mo.

Quercus Nuttallii Palmer, Jour. Arnold Arb. **8**: 52. 1927.

Low wet woods. Circumneutral. Southeastern Mo.: Butler Co.

Quercus nigra L. Water Oak.

Low woods. Circumneutral. Southeastern Mo.: Pemiscot, Dunklin, Butler, and Ripley counties.

Quercus Phellos L. Willow Oak.

Southeastern Mo. and locally north along Mississippi River: St. Louis, Madison, Bollinger, Scott, Mississippi, New Madrid, Pemiscot, Dunklin, Stoddard, Butler, and Ripley counties.

Quercus marilandica Muench. Black Jack Oak.

Dry or rocky upland woods. Oxylophile to circumneutral. General, but commonest in the Ozark region.

Quercus imbricaria Michx. Shingle Oak.

Upland woods and along small streams. Circumneutral. General but apparently absent from a number of the Ozark and southwestern counties.

Quercus velutina Lam. Black Oak.

Upland woods and well-drained ground along streams. Oxylophile to circumneutral. General and probably in every county.

Quercus velutina var. **missouriensis** Sarg.

In similar situations to the last. General but scattered and commonest in the Ozark region: Clark, Audrain, Shannon, Dunklin, Ozark, Taney, Stone, Barry, Jackson, Jasper, and McDonald counties.

Quercus leiodermis Ashe, Jour. Elisha Mitchell Sci. Soc. **40**: 43. 1924.

Upland woods. Circumneutral. Jackson and St. Clair counties. Perhaps only a form of *Q. velutina*.

× **Quercus Hillii** Trelease, Proc. Am. Phil. Soc. **56**: 49. 1917.

A hybrid between *Q. macrocarpa* and *Q. Muhlenbergii*. Holt and Jackson counties.

× **Quercus Bebbiana** Schneider, Handb. Laubholz. **1**: 201. 1904.

A hybrid between *Q. alba* and *Q. macrocarpa*. Marion and Jackson counties.

× **Quercus Fernowii** Trelease, Proc. Am. Phil. Soc. **56**: 49. 1917.

A hybrid between *Q. alba* and *Q. stellata*. St. Louis Co.

× **Quercus Leana** Nutt.

A hybrid between *Q. imbricaria* and *Q. velutina*. General but scattered: Adair, Boone, Jefferson, Washington, Iron, Madison, Saline, Dekalb, Jackson, Dade, and Christian counties.

× **Quercus Bushii** Sarg. Bot. Gaz. **65**: 453. 1918.

A hybrid between *Q. marilandica* and *Q. velutina*. Jackson, Johnson, and Jasper counties.

× **Quercus Porteri** Trelease, Proc. Am. Phil. Soc. **56**: 51. 1917.

A hybrid between *Q. borealis* var. *maxima* and *Q. velutina*. Clark, Dunklin, and Jackson counties.

× **Quercus exacta** Trelease, Proc. Am. Phil. Soc. **56**: 49. 1917.

A hybrid between *Q. imbricaria* and *Q. palustris*. Shelby, Jefferson, Sullivan, and Dekalb counties.

× **Quercus ludoviciana** Sarg. Trees & Shrubs **2**: 223. 1913.

× *Quercus subfalcata* Trelease.

A hybrid between *Q. falcata* and *Q. Phellos*. Carter and Butler counties.

× **Quercus Richteri** Baenitz, Allg. Bot. Zeit. **9**: 85. 1903.

A hybrid between *Q. borealis* var. *maxima* and *Q. palustris*. Osage and Benton counties.

× **Quercus runcinata** Engelm.

A hybrid between *Q. borealis* var. *maxima* and *Q. imbricaria*. St. Louis, Wayne, and Jackson counties.

× **Quercus tridentata** Engelm.

A hybrid between *Q. imbricaria* and *Q. marilandica*. St. Louis Co.

× **Quercus heterophylla** Michx. f.

A hybrid between *Q. borealis* var. *maxima* and *Q. Phellos.* Dunklin Co.

× **Quercus vaga** Palmer & Steyermark, hyb. nov.

Hybrida intermedia *Q. palustrem* et *Q. velutinam* foliis, gemmis hyemalibus fructuque.

Intermediate in character of foliage, winter buds, and fruit, between *Q. palustris* and *Q. velutina,* the supposed parent species, both of which were growing in close proximity to the type tree.

Alluvial ground along small upland streams. Northeastern Missouri, and to be expected elsewhere in the range of the parent species.

MISSOURI: Maryville, Nodaway Co., June 13, 1924, *E. J. Palmer 25421* (Arn. Arb. TYPE).

× **Quercus inaequalis** Palmer & Steyermark, hyb. nov.

Hybrida intermedia *Q. Phellos* et *Q. velutinam* foliis, gemmis hyemalibus fructuque.

Intermediate in character of foliage, winter buds, and fruit, between *Q. Phellos* and *Q. velutina,* the supposed parent species, both of which were growing near the type tree. The leaves in this hybrid are extremely variable and many of them unsymmetrical.

Low hills bordering lowlands. Southeastern Missouri to Arkansas and Louisiana.

MISSOURI: Poplar Bluff, Butler Co., Sept. 11, 1919, *E. J. Palmer 16342* (Arn. Arb. TYPE); same locality, Oct. 5, 1921, *Palmer 20676* (Arn. Arb. topotype); ARKANSAS: Hot Springs, Garland Co., Oct. 10, 1925, *E. J. Palmer 29098* (Arn. Arb.); same locality, Nov. 5, 1925, *Palmer 29577* (Arn. Arb.); Hardinville, Faulkner Co., Oct. 13, 1924, *E. J. Palmer 26505* (Arn. Arb.); LOUISIANA: near Sardis, July 30, 1915, *R. S. Cocks 814* (Arn. Arb.); same locality, Sept. 1–15, 1915, *R. S. Cocks 938* (Arn. Arb.).

× **Quercus Shirlingii** Bush, hyb. nov.

Hybrida intermedia *Q. imbricariam* et *Q. Shumardii* var. *Schneckii* foliis fructuque.

Foliage and fruit intermediate between *Q. imbricaria* and *Q. Shumardii* var. *Schneckii,* the supposed parent species, both of which were growing with the type tree. This species is named in honor of Professor A. E. Shirling, of Teachers' College at Kansas City, Missouri.

MISSOURI: Oak Grove, Jackson Co., Oct. 22, 1927, *B. F. Bush 11637* (Arn. Arb. TYPE).

× **Quercus mutabilis** Palmer & Steyermark, hyb. nov.

Hybrida intermedia *Q. palustrem* et *Q. Shumardii* var. *Schneckii* foliis fructuque.

Intermediate in foliage and fruit between *Q. palustris* and *Q. Shumardii* var. *Schneckii,* both of which were growing with the type tree.

Low hills bordering river valley. Western Missouri.

MISSOURI: Montieth Junction, Bates Co., Sept. 10, 1924, *E. J. Palmer 26069* (Arn. Arb. TYPE).

Fam. ULMACEAE

Ulmus americana L. White Elm, American Elm.

Woods, principally along streams. Circumneutral. General, and probably in every county.

Ulmus Thomasi Sarg. Cork Elm, Rock Elm.

Ulmus racemosa Thomas, not Borkh. (G).

Woods along streams. Circumneutral. Northern, central, and southeastern Mo.: Clark, Monroe, Boone, Stoddard, Dunklin, Atchison, and Jackson counties.

Ulmus alata Michx. Winged Elm.

Low and upland woods. Oxylophile to circumneutral. East-central and southern Mo.: Lincoln, Warren, St. Louis, Jefferson, Franklin, Gasconade, St. Francois, Ste. Genevieve, Perry, Cape Girardeau, Bollinger, Madison, Iron, Reynolds, Wayne, Stoddard, Scott, Mississippi, New Madrid, Pemiscot, Dunklin, Butler, Ripley, Carter, Oregon, Dent, Howell, Shannon, Texas, Phelps, Pulaski, Callaway, Cooper, Cole, Douglas, Ozark, Taney, Christian, Greene, Stone, Barry, and McDonald counties.

Ulmus fulva Michx. Slippery Elm, Red Elm.

Upland woods and along bluffs. Calciphile to circumneutral. General and probably in every county.

Planera aquatica (Walt.) J. F. Gmel. Water Elm, Planer Tree.

Swamps and low wet woods. Circumneutral. Southeastern Mo.: Mississippi, New Madrid, Pemiscot, Dunklin, Butler, and Ripley counties.

Celtis occidentalis L. Hackberry, Sugarberry.

Low and upland woods, mostly along streams. Circumneutral. General but less common than the varieties that follow: Mercer, Putnam, Marion, Madison, Iron, Texas, Daviess, Gentry, Dekalb, Nodaway, Buchanan, St. Clair, and Jasper counties.

Celtis occidentalis var. **crassifolia** (Lam.) Gray.

Low and upland woods along streams. Circumneutral. General: Clark, Scotland, Knox, Adair, Sullivan, Carroll, Boone, Pike, Cape Girardeau, Butler, Oregon, Shannon, Ozark, Taney, Stone, Harrison, Grundy, Livingston, Atchison, Johnson, Jasper, and McDonald counties.

Celtis occidentalis var. **canina** (Raf.) Sarg. Bot. Gaz. **67**: 217. 1919.

Low and upland woods along streams. Circumneutral. General and perhaps in every county.

Celtis laevigata Willd. Southern Hackberry.

Celtis mississippiensis Bosc, in part (G), (B & B).

Low wet woods. Eastern, central, and southern Mo.: Marion, Pike, Montgomery, Gasconade, St. Charles, St. Louis, Jefferson, Perry, Cape Girardeau, Scott, Mississippi, New Madrid, Pemiscot, Dunklin, Butler, Ripley, Shannon, Iron, Cole, Boone, Howard, Jackson, Bates, St. Clair, Jasper, McDonald, Stone, and Taney counties.

Celtis laevigata var. **texana** (Scheele) Sarg. Bot. Gaz. **67**: 223. 1919.

Celtis mississippiensis Bosc, in part (G), (B & B).

Rocky woods, glades, and bluffs. Circumneutral. Central and southern Mo.,

mainly in the Ozark region: St. Charles, Perry, Stoddard, Butler, Carter, Oregon, Shannon, Ozark, Taney, Stone, Douglas, Christian, Pulaski, Camden, Benton, Miller, Moniteau, Montgomery, Boone, Jackson, Polk, Greene, St. Clair, Cedar, Lawrence, Jasper, Newton, and McDonald counties.

Celtis pumila Pursh. Dwarf Hackberry.

Rocky woods. Calciphile to circumneutral. Central and southern Mo.: St. Louis, Madison, Carter, Shannon, Dent, Jackson, Benton, Taney, Barry, Vernon, and Newton counties.

Celtis pumila var. **georgiana** (Small) Sarg. Bot. Gaz. 67: 227. 1919.

Celtis georgiana Small (B & B).

Rocky woods, glades, and bluffs. Central and southern Mo.: Ralls, Lincoln, Montgomery, St. Francois, Ste. Genevieve, Madison, Iron, Wayne, Carter, Oregon, Shannon, Dent, Crawford, Maries, Miller, Camden, Benton, Polk, Dallas, Henry, Hickory, Ozark, Taney, Stone, St. Clair, Cedar, Vernon, Jasper, Newton, McDonald, and Barry counties.

Celtis pumila var. **Deamii** Sarg. Bot. Gaz. 67: 228. 1919.

Rocky woods and glades. Circumneutral. Southeastern Mo., Iron Mountain sub-region: St. Francois and Iron counties.

Fam. Moraceae

Maclura pomifera (Raf.) Schneider. Osage Orange, Bodarc.

Pastures, thickets, and borders of woods. Calciphile to circumneutral. Probably not native in the state, but formerly much planted for hedges and freely escaping. General but scattered and absent from many of the Ozark counties: Adair, Shelby, Audrain, St. Louis, Franklin, Gasconade, Iron, New Madrid, Pemiscot, Howell, Laclede, Livingston, Caldwell, Dekalb, Atchison, Holt, Jackson, Johnson, Bates, Vernon, St. Clair, Greene, and Jasper counties.

Broussonetia papyrifera (L.) Vent. Paper Mulberry.

Sometimes planted as a shade tree and occasionally escaping. Johnson and Butler counties.

Morus rubra L. Red Mulberry.

Low and upland woods. Circumneutral. General and probably in every county.

Morus alba L. White Mulberry.

Commonly planted and freely escaping. Indifferent. General but scattered: Clark, Marion, Ralls, Pike, Lincoln, St. Louis, Franklin, Mercer, Harrison, Sullivan, Chariton, Boone, Atchison, Holt, Andrew, Dekalb, Jackson, Johnson, Bates, Vernon, Barton, Jasper, and McDonald counties.

Cannabis sativa L. Hemp.

Thickets, open and waste ground. Circumneutral. General.

Humulus Lupulus L. Hop.

Fertile open and waste ground. Circumneutral. General.

Humulus japonicus Sieb. & Zucc. Japanese Hop.

Fertile open ground and waste places. Indifferent. Scattered: Jackson and Jasper counties.

Fam. URTICACEAE

URTICA URENS L. Dwarf Nettle.

Introduced in waste ground. Indifferent. Western Mo., local: Jackson Co.

Urtica procera Muhl. See Rh. 28: 192–195. 1926. Slender Nettle.

Urtica gracilis of most Am. auth., not Ait. (G), (B & B).

Waste or cultivated ground, rich low or alluvial woods, and fertile soils. Circumneutral. Northern and central Mo.: Marion, Lincoln, St. Charles, St. Louis, Boone, Chariton, Saline, Caldwell, Livingston, Mercer, Harrison, Worth, Knox, Adair, Shelby, Macon, Gentry, Atchison, Holt, Buchanan, Andrew, Platte, Clay, and Jackson counties.

Urtica chamaedryoides Pursh.

Low open ground. Circumneutral. Southeastern Mo.: Pemiscot Co.

Laportea canadensis (L.) Gaud. Wood Nettle.

Low rich woods. Circumneutral. General.

Pilea pumila (L.) Gray. Clearweed, Richweed.

Low woods and boggy ground along streams, and about ponds. Circumneutral. General.

Boehmeria cylindrica (L.) Sw. False Nettle.

Open woods, thickets, and moist open ground. Circumneutral. General.

Parietaria pennsylvanica Muhl. Pellitory.

Open woods, thickets, and moist open ground. Circumneutral. General.

Parietaria obtusa Rydb.

Rocky open woods and glades. Circumneutral. Local: Ozark Co.

Fam. SANTALACEAE

Comandra Richardsiana Fernald. Bastard Toadflax.

Dry rocky woods, prairies, and barrens. Oxylophile to circumneutral. General, but commonest in central and southern Mo. This has been long confused with *C. umbellata*, a northern species which does not reach Mo.

Fam. LORANTHACEAE

Phoradendron flavescens (Pursh) Nutt. Mistletoe.

Parasitic on deciduous trees; low woods and banks of streams. Southern Mo.: Scott, Mississippi, New Madrid, Stoddard, Dunklin, Butler, Ripley, Carter, Reynolds, Shannon, Oregon, Ozark, and Stone counties.

Fam. ARISTOLOCHIACEAE

Asarum canadense L. var. **acuminatum** Ashe. Wild Ginger.

Rich woods and along base of rocky bluffs. Circumneutral. General.

Asarum canadense var. **reflexum** (Bicknell) Robinson.

In similar situations to the preceding. General.

Aristolochia Serpentaria L. Virginia Snakeroot.

Rich woods and alluvial thickets. Circumneutral. Central and southern Mo.: St. Louis, Jefferson, Franklin, Cape Girardeau, Bollinger, New Madrid,

Dunklin, Butler, Ripley, Carter, Iron, Oregon, Shannon, Dent, Gasconade, Howell, Texas, Maries, Pulaski, Boone, Saline, Jackson, Henry, Wright, Webster, Greene, Christian, Douglas, Ozark, Taney, Stone, Barry, Jasper, and McDonald counties.

Aristolochia Serpentaria var. **hastata** (Nutt.) Duchartre.

Low swampy woods. Circumneutral. Southeastern Mo., local: Dunklin Co.

Aristolochia tomentosa Sims. Pipe Vine, Dutchman's Pipe.

Low woods and thickets along streams. Circumneutral. East-central and southern Mo: St. Louis, Jefferson, Franklin, Madison, Wayne, Butler, Dunklin, Ripley, Oregon, Shannon, Phelps, Pulaski, Texas, Maries, Wright, Douglas, Ozark, Greene, Stone, Lawrence, Jasper, Newton, and McDonald counties.

Fam. POLYGONACEAE

Eriogonum longifolium Nutt.

Rocky open woods and glades. Oxylophile. Southern Mo., rare and local: Oregon Co.

RUMEX ELONGATUS Guss.

Waste open ground. Indifferent. Scattered: Boone, Clay, and Jackson counties.

RUMEX PATIENTIA L. var. KURDICUS Boiss. Patience Dock.

Waste ground. Indifferent. Introduced in Clay and Jackson counties.

RUMEX BRITANNICA L. Great Water Dock.

Low ground along Missouri River. Circumneutral. Local: St. Louis Co.

RUMEX CRISPUS L. Narrow-leaved Dock, Curled Dock.

Fields and waste ground. Indifferent. General and common.

Rumex mexicanus Meisn.

Moist alluvial ground. Indifferent. Scattered: Clark, Knox, St. Louis, Saline, Mercer, Carroll, Clay, Jackson, and Holt counties.

Rumex altissimus Wood. Pale Dock.

Fields, thickets, waste, and alluvial ground. Circumneutral. General.

Rumex verticillatus L. Swamp Dock.

Swamps and low wet woods. Circumneutral. General.

RUMEX SANGUINEUS L.

Waste ground. Indifferent. Locally introduced in St. Louis Co.

RUMEX OBTUSIFOLIUS L. Bitter Dock, Broad-leaved Dock.

Fields, waste ground, and about dwellings. Indifferent. General.

Rumex maritimus L. var. **fueginus** (Philippi) Dusén. See Rh. **17**: 80–81. 1915.

Sand bars and alluvial ground along the larger rivers. Circumneutral. Central and northwestern Mo.: St. Louis, Franklin, Perry, Boone, Saline, Carroll, Holt, Buchanan, Clay, and Jackson counties. This has been confused with *Rumex persicaroides*, which is not known in Mo.

Rumex hastatulus Baldw.

Rocky prairies, glades, and sandy open ground. Oxylophile. Scattered in east-central and southern Mo.: St. Louis, Ste. Genevieve, Scott, Dunklin, and Newton counties.

Rumex Acetosella L. Sour Dock, Sheep Sorrel.

Fields and waste ground. Oxylophile. General.

Rumex crispus × obtusifolius.

Sometimes occurring locally with the parent species. St. Louis, Jefferson, and Carroll counties.

Polygonum exsertum Small.

Low alluvial meadows, prairies, and muddy banks. Circumneutral. General.

Polygonum prolificum (Small) Robinson.

Open ground. Indifferent. Local: Clay and Jackson counties.

Polygonum aviculare L. Knotweed, Knot-grass.

Fields, waste ground, and about dwellings. Indifferent. General and common.

Polygonum aviculare var. **vegetum** Ledeb.

In similar situations to the typical form. Indifferent. Scattered.

Polygonum aviculare var. **angustissimum** Meisn.

Polygonum neglectum Bess. (B & B).

With the typical form and often commoner. Indifferent. General.

Polygonum buxiforme Small.

Polygonum littorale of auth., not Link (B & B).

Polygonum aviculare var. *littorale* (G).

Fields and waste ground. Indifferent. General.

Polygonum erectum L.

Low wet woods and alluvial banks of streams and ponds. Circumneutral. General.

Polygonum ramosissimum Michx.

Prairies and open ground, usually in moist alluvial soil. Circumneutral. General.

Polygonum achoreum Blake, Rh. **19**: 232. 1917.

Introduced in waste ground. Jackson Co.

Polygonum triangulum Bicknell in Britton & Brown, Ill. Fl. ed. 2. **1**: 664, *fig. 1626*. 1913.

Fields and waste ground. Indifferent. Jackson Co.

Polygonum tenue Michx.

Rocky prairies, glades, and gravel bars along streams. Oxylophile. Central and southern Mo.: Lincoln, Boone, Montgomery, Warren, St. Charles, Gasconade, Crawford, Jefferson, Ste. Genevieve, St. Francois, Perry, Madison, Bollinger, Iron, Reynolds, Stoddard, Dunklin, Shannon, Phelps, Howell, Pulaski, Maries, Camden, Dallas, Polk, St. Clair, Greene, Jackson, Jasper, Newton, McDonald, and Barry counties.

Polygonum lapathifolium L. See Rh. **23**: 258–259. 1921.

Polygonum lapathifolium var. *nodosum* (Pers.) Weinmann (G).

Wet open ground about ponds and sloughs, and in waste ground. Indifferent. General.

Polygonum densiflorum Meisn.

Low open ground. Circumneutral. Southeastern Mo.: Scott, Dunklin, and Carter counties.

Polygonum coccineum Muhl. See Rh. **27**: 162. 1925.
Polygonum Muhlenbergii (Meisn.) Wats. (G).
Persicaria Muhlenbergii (Wats.) Small (B & B).
Prairies and open woods, and borders of streams, ponds, and sloughs. Circumneutral. General.

Polygonum coccineum var. **pratincola** (Greene) Stanford, Rh. **27**: 165. 1925.
In similar situations to the typical form. Local: Jackson Co.

Polygonum natans Eat.
Polygonum amphibium of Am. auth., not L. (G).
Persicaria amphibia S. F. Gray (B & B).
In shallow water. Local: Greene Co.

Polygonum pensylvanicum L.
Wet ground along borders of streams, ponds, and sloughs, and in waste ground. Indifferent. General.

Polygonum pensylvanicum var. **laevigatum** Fernald, Rh. **19**: 73. 1917.
Frequently found with the typical form.

Polygonum longistylum Small. See Rh. **27**: 182. 1925.
Wet or moist open ground along prairie streams. Circumneutral. Central and southern Mo.; scattered: New Madrid, Dunklin, Clay, Jackson, and Jasper counties.

Polygonum Hydropiper L. var. **projectum** Stanford, Rh. **29**: 86. 1927. Smartweed, Water Pepper.
Polygonum Hydropiper of auth. in part, not L. (G).
Persicaria Hydropiper of auth., not Opiz (B & B).
Wet woods and prairies, along sloughs and streams. Circumneutral. General.

Polygonum punctatum Ell. Smartweed, Water Pepper.
Polygonum acre HBK, not Lam., in part (G).
Polygonum acre var. *leptostachyum* Meisn., in part (G).
Persicaria punctata (Ell.) Small (B & B).
Wet ground, borders of ponds and sloughs. Circumneutral. General.

Polygonum robustius (Small) Fernald, Rh. **23**: 147. 1921.
Low wet woods and borders of sloughs. Circumneutral. Southeastern Mo.: Dunklin Co.

POLYGONUM ORIENTALE L. Prince's Feather.
Waste ground; escaped from cultivation. Indifferent. Scattered: St. Louis, Boone, Miller, Greene, Taney, Clay, Jackson, Cass, and Jasper counties.

POLYGONUM PERSICARIA L. Lady's Thumb.
Waste and cultivated ground. Circumneutral. General.

Polygonum setaceum Baldw.
Swampy open ground and low open woods. Circumneutral. Southeastern Mo.: Dunklin, Butler, and Ripley counties.

Polygonum hydropiperoides Michx. See Rh. **28**: 24. 1926.
Wet open ground about ponds, streams, and spring branches. Circumneutral. General.

Polygonum hydropiperoides f. strigosum (Small) Stanford, Rh. **28**: 26. 1926.
Polygonum hydropiperoides var. *strigosum* Small (G).
Occasionally found with the typical form.

Polygonum opelousanum Riddell. See Rh. **28**: 27. 1926.
Persicaria opelousana (Riddell) Small (B & B).
Low wet woods. Circumneutral. Southern Mo.: Dunklin, Butler, Ripley, Jasper, Newton, and McDonald counties.

Polygonum virginianum L.
Rich woods. Circumneutral. General.

Polygonum arifolium L. Halberd-leaved Tear-thumb.
Wet or moist open ground. Circumneutral. Southeastern Mo., local: Stoddard Co.

Polygonum sagittatum L. Arrow-leaved Tear-thumb.
Boggy ground about springs and streams. Oxylophile. General but scattered: Putnam, Shelby, Audrain, Boone, Randolph, Lincoln, St. Charles, St. Louis, Jefferson, St. Francois, Bollinger, Mississippi, Dunklin, Shannon, Crawford, Saline, Jackson, St. Clair, Greene, Cedar, Vernon, Barton, and Jasper counties.

POLYGONUM CONVOLVULUS L. Climbing Buckwheat, Black Bindweed.
Thickets, waste and cultivated ground. Circumneutral. General but scattered.

Polygonum scandens L. Climbing False Buckwheat.
Thickets, waste and cultivated ground. Circumneutral. General.

POLYGONUM CUSPIDATUM Sieb. & Zucc. See Rh. **32**: 223. 1930. Japanese Knotweed.
Cultivated and rarely escaped into thickets and waste places. St. Louis Co.

FAGOPYRUM ESCULENTUM Moench. Buckwheat.
Rich cultivated and waste ground. Escaped from cultivation. General but scattered.

Polygonella americana (Fisch. & Mey.) Small. Jointweed.
Glades and open sandy ground. Oxylophile. Southeastern Mo.: Iron, Stoddard, and Dunklin counties.

Brunnichia cirrhosa Gaertn. Ladies' Ear-drops.
Swamps, low wet woods, and wet thickets. Circumneutral. Southeastern Mo.: Bollinger, Mississippi, New Madrid, Pemiscot, Dunklin, Stoddard, Butler, and Ripley counties.

Fam. CHENOPODIACEAE

Cycloloma atriplicifolium (Spreng.) Coult. Winged Pigweed.
Sandy fields, rocky or sandy open ground, and along roadways and railways. Oxylophile. General but scattered: Clark, Pike, St. Charles, St. Louis, Franklin, St. Francois, Perry, Stoddard, Dunklin, Randolph, Carroll, Saline, Clay, Jackson, and Jasper counties.

KOCHIA TRICHOPHYLLA Stapf. Fire-bush, Summer Cypress
Cultivated and occasionally escaped, in fields and along railroads. Scattered: St. Louis, Callaway, McDonald, Gentry, and Andrew counties.

KOCHIA SCOPARIA (L.) Schrad. Standing Cypress, Belvedere.

Escaped from cultivation into waste ground and along railroads. Scattered: St. Louis, Jefferson, Franklin, Andrew, Buchanan, and Jackson counties.

KOCHIA PROSTRATA (L.) Schrad.

Waste ground. Indifferent. Introduced in Jackson Co.

CHENOPODIUM AMBROSIOIDES L. Mexican Tea.

Fields, rich waste ground, and about dwellings. Indifferent. General.

CHENOPODIUM AMBROSIOIDES var. ANTHELMINTICUM (L.) Gray.

Commonly found with the typical form.

CHENOPODIUM CARINATUM R. Br.

Waste ground, fields, and about dwellings, often in rocky or gravelly ground. Indifferent. Central and southern Mo., scattered: Bollinger, Ripley, Reynolds, Shannon, Oregon, Dent, Howell, Texas, Ozark, Douglas, Jackson, and Vernon counties.

CHENOPODIUM BOTRYS L. Feather Geranium, Jerusalem Oak.

Waste ground. Indifferent. Scattered: St. Louis, Shannon, Ozark, Stone, and Jackson counties.

Chenopodium capitatum (L.) **Asch.** Strawberry Blite.

Open ground. Circumneutral. Local: Pike Co.

CHENOPODIUM GLAUCUM L. Oak-leaved Goosefoot.

Waste open ground and moist alluvial ground along ponds and the larger rivers. Calciphile to circumneutral. Scattered: St. Louis, Clinton, Holt, and Jackson counties.

Chenopodium gigantospermum Aellen in Fedde, Rep. Spec. Nov. **26**: 144. 1929. Maple-leaved Goosefoot.

Chenopodium hybridum of Am. auth., not L. (G), (B & B).

Rich waste and cultivated ground. Indifferent. General.

Chenopodium gigantospermum var. **Standleyanum** Aellen in Fedde, Rep. Spec. Nov. **26**: 147. 1929.

Waste ground. Indifferent. St. Louis Co.

CHENOPODIUM ALBUM L. Pigweed, Lamb's Quarter.

Waste and cultivated ground. Indifferent. General and common. The young shoots eaten as greens.

CHENOPODIUM ALBUM f. VIRIDE (L.) Aellen in Fedde, Rep. Spec. Nov. **26**: 129. 1929.

Chenopodium album var. *viride* (L.) Moq., in part (G).

Chenopodium album L., in part (B & B).

Waste ground, in rich or moist soil. Indifferent. General.

CHENOPODIUM ALBUM f. LANCEOLATUM (Muhl.) Aellen in Fedde, Rep. Spec. Nov. **26**: 130. 1929.

Waste and low alluvial ground. Sometimes found with the typical form. Scattered.

CHENOPODIUM PAGANUM Reichenb.

Chenopodium album var. *viride* (L.) Moq., in part (G).

Chenopodium album of auth., not L., in part (B & B).

Waste and cultivated ground. Indifferent. General but scattered.

Chenopodium pratericola Rydb. Bull. Torr. Bot. Club **39**: 310. 1912.
Waste and cultivated ground. Indifferent. Jackson Co.

Chenopodium Berlandieri Moq.
Waste ground. Indifferent. General but scattered.

Chenopodium Berlandieri subsp. **Zschackei** var. **typicum** f. **latifolium** (Ludwig) Aellen in Fedde, Rep. Spec. Nov. **26**: 55. 1929.
Waste ground. Jackson Co.

Chenopodium Berlandieri subsp. **Zschackei** var. **typicum** f. **angustius** (Ludwig) Aellen in Fedde, Rep. Spec. Nov. **26**: 55. 1929.
Occasionally found with the other forms. Indifferent. Scattered: Jackson and Jasper, and probably in many other counties.

Chenopodium Berlandieri subsp. **Zschackei** var. **typicum** f. **pedunculare** Aellen in Fedde, Rep. Spec. Nov. **26**: 55. 1929.
Waste ground. Indifferent. Jackson Co.

Chenopodium Berlandieri subsp. **Zschackei** var. **typicum** f. **neglectum** Aellen. in Fedde, Rep. Spec. Nov. **26**: 55. 1929.
Waste ground. Indifferent. Jackson Co.

Chenopodium Berlandieri subsp. **Zschackei** var. **farinosum** Aellen in Fedde, Rep. Spec. Nov. **26**: 56. 1929.
Waste ground. Indifferent. Jackson Co.

Chenopodium Berlandieri subsp. **Zschackei** var. **foetens** (Ludwig) Aellen in Fedde, Rep. Spec. Nov. **26**: 57. 1929.
Waste ground. Indifferent. Jackson Co.

Chenopodium Berlandieri subsp. **Boscianum** (Moq.) Aellen in Fedde, Rep. Spec. Nov. **26**: 51. 1929.
Chenopodium Boscianum Moq. (G), (B & B).
Woods and thickets. Indifferent. Southern and central Mo., scattered: St. Louis, Jackson, Greene, and Jasper counties.

Chenopodium Standleyanum Aellen in Fedde, Rep. Spec. Nov. **26**: 153. 1929.
Chenopodium Boscianum Moq., in part.
Waste ground. Indifferent. Southern and western Mo.: Shannon, Holt, Jackson, Greene, and Jasper counties.

Chenopodium missouriense Aellen, Bot. Not. **1928**: 206, *figs.* 1928.
Chenopodium paganum Standley, N. Am. Fl. **21**: 1. 1916, not Reichenb.
Waste and cultivated ground. Indifferent. General, but scattered: St. Louis, Jackson, and Jasper counties, and probably in many others.

Chenopodium missouriense var. **Bushianum** Aellen in Fedde, Rep. Spec. Nov. **26**: 156. 1929.
Waste ground. Indifferent. Jackson Co.

Chenopodium glaucophyllum Aellen in Fedde, Rep. Spec. Nov. **26**: 155. 1929.
Waste ground. Indifferent. Jackson Co.

Chenopodium Bushianum Aellen in Fedde, Rep. Spec. Nov. **26**: 63. 1929.
Rocky open and waste ground. Indifferent. Western Mo.: Jackson, St. Clair, Greene, and Ozark counties.

Chenopodium leptophyllum Nutt.

Rocky or sandy open ground. Oxylophile. Western Mo.: Jackson and Jasper counties, and probably in many others.

Chenopodium leptophyllum var. **leptophylloides** (Murr.) Thellung & Aellen in Fedde, Rep. Spec. Nov. **26**: 134. 1929.

Chenopodium leptophyllum var. *oblongifolium* Wats. (G).

Chenopodium leptophyllum Nutt. in part (B & B).

Waste and cultivated ground. Indifferent. General but scattered: St. Louis, Jackson, Jasper, and probably in many other counties.

Chenopodium incanum (Wats.) Heller.

Open waste ground. Indifferent. Introduced from the western plains. Jackson Co.

Chenopodium dacoticum Standley, N. Am. Fl. **21**: 22. 1916.

Prairies and fields. Indifferent. Western Mo.: Atchison and Jackson counties.

CHENOPODIUM MURALE L.

Waste ground and about dwellings. Indifferent. General but scattered: Warren, St. Louis, Texas, Boone, Jackson, Greene, Taney, and Jasper counties.

CHENOPODIUM URBICUM L.

Waste ground, dumps, and about dwellings. Indifferent. General.

CHENOPODIUM URBICUM var. INTERMEDIUM (Mert. & Koch) Koch.

Commonly occurring with the typical form.

× **Chenopodium variabile** var. **Murrii** Aellen in Fedde, Rep. Spec. Nov. **26**: 157. 1929.

A supposed hybrid between *Chenopodium album* and *C. Berlandieri* subsp. *Zschackei* var. *typicum*.

Waste ground. Jackson Co.

ATRIPLEX ROSEA L. Red Scale.

Waste and saline soil. Calciphile. Central Mo.: Howard and Jackson counties.

Atriplex patula L. Spear Scale.

Rich cultivated or waste ground. Indifferent. Northern and central Mo.: Knox, St. Louis, Putnam, and Jackson counties.

Atriplex patula var. **hastata** (L.) Gray.

Rocky or waste ground, and around saline springs and licks. Indifferent. Scattered: St. Louis, Callaway, Boone, Randolph, Jackson, and Jasper counties.

Atriplex argentea Nutt. Silver Scale.

Dry open ground. Indifferent. Introduced in Jackson Co.

Monolepis Nuttalliana (R. & S.) Wats.

Introduced in waste ground. Jackson Co.

AXYRIS AMARANTOIDES L. See Rh. **29**: 223. 1927.

Introduced in waste ground. Jackson Co.

Corispermum nitidum Kit. Bug-seed.

Sandy open ground. Oxylophile. Introduced in Jackson Co.

Corispermum hyssopifolium L. Bug-seed.

Sand bars of the large rivers. Oxylophile. Scattered: St. Louis, Perry, Clay, and Jackson counties.

Corispermum orientale L. var. **emarginatum** (Rydb.) Macbride, Contr. Gray Herb. N. S. **53**: 13. 1918.

Sandy open ground. Oxylophile. Introduced in Jackson Co.

Suaeda depressa (Pursh) Wats. Sea Blite.

Sandy open ground. Oxylophile. Introduced in Jackson Co.

Salsola Kali L.

Open waste ground. Introduced in Jackson Co.

SALSOLA KALI var. TENUIFOLIA G. F. W. Mey. Russian Thistle.

Dry or rocky open ground and waste places. Calciphile to circumneutral. Introduced from farther west. Scattered: St. Louis, St. Francois, Saline, Carroll, Atchison, Holt, Andrew, Buchanan, Platte, Clay, Jackson, and Jasper counties.

Fam. AMARANTHACEAE

Amaranthus Palmeri Wats.

Waste ground and along railroads. Indifferent. Introduced in Jackson Co.

AMARANTHUS HYBRIDUS L. Pig-weed, Green Amaranth.

Fields, gardens, and waste ground. Indifferent. General and common. The young shoots eaten as greens.

AMARANTHUS HYBRIDUS var. HYPOCHONDRIACUS (L.) Robinson. Prince's Feather.

Cultivated and rarely escaped. Scattered.

AMARANTHUS RETROFLEXUS L. Pig-weed, Green Amaranth.

Cultivated and waste ground. Indifferent. General.

AMARANTHUS PANICULATUS L. Purple Amaranth.

Escaped from gardens to roadsides and waste ground. Uncommon and scattered: St. Louis, Saline, and Jackson counties, and reported from Boone Co.

Amaranthus graecizans L. Tumble-weed.

Fields, waste places, and rocky open ground. Indifferent. General.

Amaranthus graecizans var. **pubescens** Uline & Bray.

Waste and cultivated ground. Occasionally growing with the typical form. Jackson Co.

Amaranthus blitoides Wats. Spreading Pig-weed.

Waste and cultivated ground. Indifferent. General.

AMARANTHUS SPINOSUS L. Spiny Amaranth.

Waste and cultivated ground. Indifferent. General.

Acnida tuberculata Moq. Water Hemp.

Wet ground about sloughs, ponds, and streams. Circumneutral. Scattered, but commonest along the large rivers.

Acnida tuberculata var. **prostrata** (Uline & Bray) Robinson.

Sand bars and mud flats along streams, and in waste ground. Circumneutral. Scattered: Pike, St. Louis, and Jackson counties.

Acnida tuberculata var. **subnuda** Wats.
Commonly occurring with the typical form.

Acnida tamariscina (Nutt.) Wood. Water Hemp.
Cultivated fields and waste ground, mostly in moist alluvial soil. Circumneutral. General.

Cladothrix lanuginosa Nutt.
Introduced from the Southwest. Waste ground. Jackson Co.

Iresine paniculata (L.) Ktze. Blood-leaf, Juba's Bush.
Low wet woods and thickets. Central and southern Mo., scattered: St. Louis, Jefferson, Franklin, Ripley, Dent, Pulaski, Maries, Ozark, Jasper, Newton, and McDonald counties.

Froelichia floridana (Nutt.) Moq.
Froelichia campestris Small (B & B).
Sandy open ground and along railroads. Oxylophile. Eastern and central Mo., mostly near the larger rivers: Lewis, St. Louis, Madison, Scott, Mississippi, Dunklin, Butler, Reynolds, Boone, and Jackson counties.

Froelichia gracilis Moq.
Dry rocky ground and sandy barrens. Oxylophile. Eastern, central, and southern Mo.: Marion, Lincoln, St. Charles, St. Francois, Perry, Bollinger, Wayne, Dunklin, Howard, Moniteau, Jackson, and Jasper counties.

Fam. PHYTOLACCACEAE

Phytolacca americana L. See Rh. **17**: 180. 1915. Pokeweed, Pokeberry.
Phytolacca decandra L. (G).
Fields, roadsides, and waste ground. Indifferent. General and probably in every county. The young shoots eaten as greens by the country people, and the juice of the ripe berries formerly used as ink.

Fam. NYCTAGINACEAE

Oxybaphus nyctagineus (Michx.) Sweet. Wild Four-o'clock.
Allionia nyctaginea Michx. (B & B).
Open and waste ground. Circumneutral. General.

Oxybaphus floribundus Chois. Umbrella-wort.
Rocky open slopes and glades. Calciphile. General but scattered: Clark, St. Louis, Jefferson, Wayne, Ripley, Dent, Holt, Carroll, Jackson, and Jasper counties.

Oxybaphus hirsutus (Pursh) Sweet.
Dry open ground and glades. Circumneutral. Scattered: Nodaway, Boone, Ozark, and Jackson counties.

Oxybaphus hirsutus var. **integrifolius** Chois.
Oxybaphus pilosus (Nutt.) Sweet.
Glades and rocky open ground. Calciphile. Southwestern Mo.: McDonald Co.

Oxybaphus albidus (Walt.) Sweet. Umbrella-wort.

Allionia albida Walt. (B & B).

Allionia bracteata Rydb. (R).

Allionia lanceolata of Standley, not Rydb.

Rocky open woods, prairies, glades, and open ground. Calciphile to circumneutral. General: Holt, Worth, Gentry, Dekalb, St. Louis, Warren, Montgomery, Mississippi, Stoddard, Ripley, Shannon, Maries, Crawford, Dent, Phelps, Pulaski, Boone, Clinton, Jackson, Dallas, Polk, Hickory, Laclede, Johnson, Henry, Greene, Ozark, Vernon, Jasper, and McDonald counties.

Oxybaphus linearis (Pursh) Robinson.

Allionia linearis Pursh (B & B).

Oxybaphus Bushii Britton.

Rocky prairies and glades. Calciphile. Central and southern Mo.: St. Louis, Ste. Genevieve, Washington, Boone, Pulaski, Wright, Taney, Jackson, Benton, Jasper, Newton, and Barry counties.

Fam. Illecebraceae

Anychia polygonoides Raf. Forked Chickweed.

Rocky open woods and glades. Oxylophile. General: Mercer, Sullivan, Linn, Randolph, Shelby, Monroe, Audrain, Boone, Lincoln, St. Louis, Jefferson, St. Francois, Mississippi, Pemiscot, Dunklin, Ripley, Oregon, Carter, Shannon, Reynolds, Iron, Dent, Texas, Phelps, Pulaski, Maries, Miller, Camden, Laclede, Hickory, Dallas, Greene, Ozark, Jackson, Henry, Cedar, Jasper, Newton, and McDonald counties.

Anychia canadensis (L.) BSP.

Dry open woods. Oxylophile to circumneutral. General: Schuyler, Putnam, Sullivan, Knox, Shelby, Ralls, Boone, Warren, St. Louis, Jefferson, Ste. Genevieve, St. Francois, Bollinger, Wayne, Ripley, Shannon, Reynolds, Dent, Phelps, Howell, Douglas, Taney, Christian, Dallas, Webster, Greene, Hickory, Dekalb, Clinton, Jackson, Johnson, Vernon, Jasper, McDonald, and Barry counties.

Fam. Aizoaceae

Mollugo verticillata L. Carpet-weed.

Waste and cultivated ground. Indifferent. General and common.

Geocarpon minimum Mack. Torreya **14**: 67. 1914.

Sandy barrens. Oxylophile. Rare and local: Jasper Co.

Fam. Caryophyllaceae

Spergula arvensis. Corn Spurrey.

Waste and cultivated ground. Indifferent. Scattered: Jackson, Greene, and Jasper counties.

Sagina decumbens (Ell.) T. & G. Pearlwort.

Waste ground, fallow fields, and rocky open or sandy ground, usually in alluvial or sandy soils. Oxylophile to circumneutral. Central and southern Mo.: Boone, Callaway, St. Louis, Jefferson, Franklin, Ste. Genevieve, St. Francois, Bollinger, Madison, Dunklin, Butler, Ripley, Oregon, Reynolds, Wayne,

Dent, Shannon, Texas, Osage, Phelps, Maries, Pulaski, Miller, Camden, Dallas, Laclede, Polk, Webster, Henry, Douglas, Greene, Cedar, Saline, Vernon, Jasper, and Newton counties.

ARENARIA SERPYLLIFOLIA L. Thyme-leaved Sandwort.

Sandy or rocky soil, glades, fields, ledges, and open places. Calciphile to circumneutral. General and common.

Arenaria patula Michx. Sandwort.

Glades and rocky prairies. Calciphile to circumneutral. Central and southern Mo.: Boone, Callaway, St. Louis, Jefferson, Franklin, Gasconade, Osage, Washington, St. Francois, Ste. Genevieve, Perry, Iron, Reynolds, Dunklin, Ripley, Oregon, Shannon, Maries, Texas, Phelps, Pulaski, Laclede, Camden, Miller, Cole, Hickory, Greene, Wright, Webster, Douglas, Christian, Taney, Ozark, Stone, Polk, Dade, St. Clair, Cedar, Barry, Jackson, Vernon, Jasper, Newton, and McDonald counties.

Arenaria stricta Michx. var. **texana** Robinson. Rock Sandwort.

Rocky slopes, ledges along bluffs, and glades. Calciphile to circumneutral. Eastern, central, and southern Mo.: Monroe, Lincoln, Jefferson, St. Francois, Washington, Boone, Camden, Texas, Greene, Christian, and McDonald counties.

Stellaria pubera Michx. var. **silvatica** (Béguinot) Weatherby, Rh. **26**: 171. 1924. Great Chickweed.

Alsine pubera (Michx.) Britton, in part (B & B).

Shaded slopes along bluffs. Circumneutral. Eastern Mo., local: Franklin Co.

STELLARIA MEDIA (L.) Cyrill. Chickweed.

Alsine media L. (B & B).

Waste ground, lawns, and cultivated ground. Indifferent. General.

Stellaria longifolia Muhl. Long-leaved Stitchwort.

Alsine longifolia (Muhl.) Britton (B & B).

Low open woods and moist meadows. Circumneutral. Eastern Mo.: Scotland, St. Louis, Jefferson, Madison, and Cape Girardeau counties.

STELLARIA GRAMINEA L. Narrow-leaved Stitchwort.

Alsine graminea (L.) Britton (B & B).

Lawns, meadows, and waste ground. Indifferent. Introduced in Boone Co.

CERASTIUM VULGATUM L. var. HIRSUTUM Fries. See Rh. **22**: 178. 1920. Mouse-ear, Chickweed.

Cerastium vulgatum of auth., not L. (G), (B & B).

Waste and cultivated ground, and moist meadows. Indifferent. General and common.

Cerastium brachypodum (Engelm.) Robinson.

Rich open woods, rocky slopes, moist meadows, waste and cultivated ground. Circumneutral. Commonest in eastern, central, and southern Mo. and locally north in Schuyler and Atchison counties.

Cerastium nutans Raf. Nodding Chickweed.

Moist meadows, rich rocky woods, cultivated and waste ground. Indifferent. General.

CERASTIUM VISCOSUM L. Clammy Chickweed.

Moist alluvial and cultivated ground, and wet rocky woods. Oxylophile to circumneutral. General.

Cerastium arvense L. var. **oblongifolium** (Torr.) Hollick & Britton.

Low wet ground, and on moist siliceous or granitic rocks. Oxylophile. Eastern Mo., south of Missouri River: St. Louis, Jefferson, St. Francois, Ste. Genevieve, Madison, Iron, and Wayne counties.

AGROSTEMMA GITHAGO L. Corn Cockle.

Cultivated and waste ground, and along roadsides and railroads. Indifferent. General.

DIANTHUS DELTOIDES L. Maiden Pink.

Introduced in waste ground. Franklin Co.

DIANTHUS ARMERIA L. Deptford Pink.

Rocky open woods, sandy open and waste ground. Oxylophile to circumneutral. Central and southern Mo. south and east of a line from Lincoln, Montgomery, Boone, and Henry counties to McDonald Co.

DIANTHUS BARBATUS L. Sweet William.

Cultivated and rarely escaped to roadsides and waste ground. Jasper Co.

LYCHNIS ALBA Mill. White Campion.

Waste and cultivated ground. Indifferent. Scattered: Harrison, Marion, Lincoln, Warren, St. Louis, Franklin, Bollinger, Pulaski, Howell, Texas, Boone, Saline, Clay, Jackson, and Jasper counties.

LYCHNIS DIOICA L. Red Campion.

Escaped into waste ground. Jackson Co. This has sometimes been mistaken for *Silene noctiflora*.

Silene antirrhina L. Sleepy Catchfly.

Field, open woods, and cultivated and waste ground. Indifferent. General.

Silene antirrhina var. **divaricata** Robinson.

Occasionally occurring with the typical form. Holt and Jackson counties.

Silene nivea (Nutt.) Otth.

Moist or wet banks of streams, and also introduced in waste ground and along railroads. Circumneutral. Northern and central Mo.: Sullivan, Boone, and Audrain counties.

SILENE LATIFOLIA (Mill.) Britten & Rendle. Bladder Campion.

Introduced in Platte and Jackson counties.

SILENE NOCTIFLORA L. Night-flowering Catchfly.

Waste and cultivated ground. Indifferent. Scattered: St. Louis, Franklin, Boone, Saline, and Jasper counties.

SILENE GALLICA L.

Old fields and waste ground. Indifferent. Cape Girardeau and Jackson counties.

Silene virginica L. Indian Pink, Fire Pink.

Rocky woods and along moist cliffs and banks. Oxylophile to circumneutral. East-central and southern Mo., mostly in the Ozark region: Montgomery, Jefferson, Ste. Genevieve, St. Francois, Washington, Crawford, Bollinger, Madison,

Wayne, Carter, Butler, Iron, Reynolds, Shannon, Dent, Oregon, Howell, Texas, Wright, Webster, Greene, Douglas, Ozark, Taney, Stone, Barry, and McDonald counties.

Silene regia Sims. Royal Catchfly.

Rocky prairies, rocky open woods, and thickets. Circumneutral. East-central and southern Mo., Ozark region: St. Louis, Jefferson, Franklin, Washington, Crawford, Dent, Shannon, Texas, Phelps, Pulaski, Maries, Miller, Cole, Greene, Barry, Jasper, and McDonald counties.

Silene stellata (L.) Ait. f. Starry Campion.

Rich upland woods and thickets. Circumneutral. General.

Silene Wherryi Small, Torreya **26**: 66, *fig.* 1926.

Rocky chert woods and bluffs. Oxylophile to circumneutral. Central Ozark region, southern Mo.: Phelps, Dent, Texas, Shannon, Pulaski, Laclede, and Douglas counties.

Silene Wherryi × **virginica.**

Rocky chert woods, growing with the parent species. Local: Shannon Co.

SAPONARIA OFFICINALIS L. Bouncing Bet, Soapwort.

Cultivated in old gardens and freely escaped into fields, gravel bars, and waste ground, and along roadsides and railroads. Indifferent. General.

SAPONARIA VACCARIA L. Cow-herb.

Open waste ground, and along railroads and roadsides. Indifferent. Scattered: Marion, Ralls, Greene, Jackson, and Jasper counties.

Fam. PORTULACACEAE

Claytonia virginica L. Spring Beauty.

Rich or rocky woods and prairies. Circumneutral. General.

Claytonia virginica f. **robusta** (Somes) Palmer & Steyermark, comb. nov.

Claytonia multicaulis var. *robusta* Somes.

Claytonia robusta (Somes) Rydb.

Occasionally found with the typical form, growing in rich woods. Circumneutral. Scattered: Ste. Genevieve, Madison, Boone, Cooper, Jackson, Douglas, and Jasper counties.

Talinum parviflorum L.

Glades and barrens. Oxylophile, usually on sandstone or chert and occasionally on leached limestone. Southern Mo.: St. Charles, St. Louis, Jefferson, Ste. Genevieve, Madison, Shannon, Texas, Polk, Greene, Cedar, Dade, Lawrence, Vernon, Jasper, and Newton counties.

Talinum calycinum Engelm. Rock Pink, Flame Flower.

Glades and exposed rocky ledges. Oxylophile to circumneutral; usually found on sandstone, chert, or granitic rocks, but occasionally on limestone. Central and southern Mo.: Montgomery, Lincoln, St. Louis, Jefferson, Franklin, St. Francois, Ste. Genevieve, Madison, Iron, Ripley, Shannon, Texas, Gasconade, Wright, Laclede, Pulaski, Maries, Miller, Dallas, Cooper, Benton, Polk, Hickory, St. Clair, Cedar, Greene, Ozark, Taney, Stone, Barry, Jackson, Vernon, Jasper, and Newton counties.

PORTULACA OLERACEA L. Purslane, Pursley.

Cultivated and waste ground. Indifferent. General and common.

Portulaca neglecta Mack. & Bush.

Rich alluvial fields and prairies. Western Mo.: Jackson, Johnson, and Jasper counties.

Portulaca retusa Engelm. Notched Purslane.

Limestone and chert glades. Oxylophile to circumneutral. Southwestern Mo.: Jasper and Newton counties.

Portulaca parvula Gray. See N. Am. Fl. **21**: 334. 1922.

Portulaca pilosa of auth., not L. (G), (B & B).

Rocky prairies and glades. Oxylophile to circumneutral. Western Mo., south of Missouri River: Jackson, Polk, Greene, Barton, Jasper, and Newton counties.

PORTULACA GRANDIFLORA Hook. Portulaca, Rose Moss.

Common in cultivation and occasionally escaped into waste or open ground.

Fam. CERATOPHYLLACEAE

Ceratophyllum demersum L. Hornwort.

Sloughs, sluggish streams, and ponds. Circumneutral. General but scattered: St. Charles, St. Louis, Perry, Dunklin, Reynolds, Oregon, Pulaski, Texas, Boone, Saline, Jackson, Barton, and Jasper counties.

Fam. NYMPHAEACEAE

Nymphozanthus advena (Ait.) Fernald, Rh. **21**: 186. 1919. Spatter Dock, Yellow Pond-lily.

Nymphaea advena Ait. (G), (B & B).

Ponds, sloughs, and slow streams. General but scattered: Lincoln, St. Charles, St. Louis, Jefferson, Franklin, Dunklin, Butler, Laclede, Bates, Vernon, Barton, Jasper, and Newton counties.

Nymphozanthus ozarkanus (Miller & Standley) Palmer & Steyermark, comb. nov.

Nymphaea ozarkana Miller & Standley, Contr. U. S. Nat. Herb. **16**: 91. 1912.

Ponds, sloughs, and streams. Circumneutral. Southern Mo., mostly in the eastern Ozark region: Washington, Dent, Iron, Reynolds, Carter, Ripley, Oregon, Shannon, Texas, Howell, Douglas, Dallas, Greene, and Taney counties.

Nymphaea tuberosa Paine, See Rh. **18**: 120. 1916. Tuberous Water-lily.

Castalia tuberosa (Paine) Greene (G), (B & B).

Slow streams and ponds. Circumneutral. Eastern Mo., scattered: St. Louis and Dunklin counties.

Nymphaea odorata Ait. Water-lily, sweet-scented Water-lily.

Castalia odorata (Ait.) Woodville & Wood (G), (B & B).

Ponds and sloughs. Circumneutral. Scattered: St. Louis, Butler, Boone, Ray, Vernon, Barton, and Jasper counties. Often cultivated and escaped in places.

Nelumbo pentapetala (Walt.) Fernald, Rh. **36**: 23–24. 1934. Yanquapin, Water Chinquapin, Yellow Lotus.

Nelumbo lutea (Willd.) Pers. (G), (B & B).

Lakes, ponds, and sloughs. Circumneutral. General but scattered: Harrison, Adair, Audrain, Boone, Lincoln, St. Charles, St. Louis, Stoddard, Dunklin, Carter, Shannon, Phelps, Laclede, Camden, Webster, Greene, Dade, Buchanan, Platte, Jackson, Cass, Bates, Barton, Jasper, and Newton counties.

NELUMBO NUCIFERA Gaertn. Oriental Lotus.

Introduced in a lake in Iron Co.

Cabomba caroliniana Gray. Carolina Water-shield.

Swamps and sloughs. Circumneutral. Eastern Mo.: St. Charles, St. Louis, Wayne, Dunklin, and Butler counties.

Brasenia Schreberi Gmel. Water-shield.

Ponds and sloughs. Circumneutral. East-central and southern Mo., scattered: Audrain, St. Charles, St. Louis, St. Francois, Iron, Texas, Taney, Barton, and Jasper counties.

Fam. RANUNCULACEAE

Ranunculus aquatilis L. var. **capillaceus** DC. White Water Crowfoot.

Sloughs, ponds, and streams. Circumneutral. Central and southern Mo.: St. Louis, Crawford, Butler, Ripley, Oregon, Shannon, Pulaski, Howell, Laclede, Dallas, Greene, Jackson, Jasper, and Newton counties.

Ranunculus longirostris Godron.

Ponds. Circumneutral. Local: St. Louis Co.

Ranunculus delphinifolius Torr. Yellow Water Crowfoot.

Ranunculus delphinifolius var. *terrestris* (Gray) Farwell, a mere terrestrial state of the above.

Swamps, bayous, ponds, and streams, in shallow water or on muddy banks. Circumneutral. Scattered, mostly near the larger rivers and absent from most of the Ozark region: Shelby, Ralls, St. Charles, St. Louis, Jefferson, Madison, Bollinger, Scott, Dunklin, Butler, Livingston, Buchanan, and Jackson counties.

Ranunculus Cymbalaria Pursh f. **hebecaulis** Fernald, Rh. **16**: 162. 1914. Seaside Crowfoot.

Sand bars and sandy open ground. Calciphile to circumneutral. Western Mo., northward from the Missouri River: Holt, Clay, and Jackson counties.

Ranunculus laxicaulis (T. & G.) Darby. Water Plantain Spearwort.

Moist open ground and borders of sloughs and ditches. Circumneutral. Scattered: Montgomery and Greene counties.

Ranunculus oblongifolius Ell. Spearwort.

Low wet woods and swamps. Oxylophile to circumneutral. East-central and southern Mo.: St. Charles, St. Louis, Jefferson, Mississippi, New Madrid, Dunklin, Howell, Butler, Webster, Greene, Barton, and Jasper counties.

Ranunculus pusillus Poir.

Swamps and low wet woods. Circumneutral. Eastern Mo., south of the Missouri River: St. Louis, Iron, Mississippi, New Madrid, Dunklin, Butler, and Texas counties.

Ranunculus sceleratus L. Cursed Crowfoot.

Moist alluvial open ground and sand bars. Northern and central Mo., mostly

near the larger rivers: Marion, Montgomery, St. Charles, St. Louis, Ste. Genevieve, Boone, Howard, Saline, Gentry, Holt, Platte, Jackson, and Vernon counties.

Ranunculus micranthus Nutt.

Open rocky woods, and moist or alluvial open ground. Circumneutral. Eastern, central, and southern Mo.: Adair, Pike, St. Louis, Jefferson, Franklin, St. Francois, Oregon, Shannon, Crawford, Phelps, Howell, Boone, Moniteau, Montgomery, Clay, Jackson, Greene, Taney, Barry, Jasper, Newton, and McDonald counties.

Ranunculus abortivus L. Small-flowered Crowfoot.

Moist alluvial or rocky woods, and open or waste ground. Circumneutral. General.

Ranunculus Harveyi (Gray) Britton.

Rocky open woods and ledges. Oxylophile to circumneutral. Central and southern Mo.: Montgomery, Gasconade, Osage, St. Louis, Jefferson, Washington, Franklin, Crawford, Dent, Madison, Wayne, Iron, Reynolds, Carter, Maries, Phelps, Pulaski, Texas, Camden, Dallas, Laclede, Greene, Barry, and McDonald counties.

Ranunculus Harveyi f. **pilosus** (Benke) Palmer & Steyermark, comb. nov.

Ranunculus Harveyi var. *pilosus* Benke, Rh. **30**: 200. 1928.

Sometimes occurring with the typical form, but scarcely distinct enough to deserve varietal rank.

Ranunculus recurvatus Poir. Hooked Crowfoot.

Rich or rocky open woods. Circumneutral. General.

Ranunculus fascicularis Muhl. Prairie Buttercup.

Rocky prairies, open woods, banks, and glades. Circumneutral to oxylophile. General.

Ranunculus septentrionalis Poir. Swamp Buttercup.

Rich or wet woods, and borders of sloughs and ponds. Circumneutral. General.

Ranunculus caricetorum Greene.

Ranunculus sicaeformis Mack. & Bush.

Low wet prairies. Circumneutral. Local: Jackson Co. Similar to the last and perhaps not specifically distinct.

Ranunculus hispidus Michx.

Rocky open woods. Circumneutral to oxylophile. General but commonest in the Ozark region: Marion, St. Louis, Jefferson, Franklin, Bollinger, Iron, Wayne, Ripley, Shannon, Texas, Warren, Boone, Cole, Morgan, Camden, Howell, Greene, Webster, Douglas, Christian, Stone, Barry, Platte, Jackson, Jasper, Newton, and McDonald counties.

Ranunculus hispidus var. **falsus** Fernald, Rh. **22**: 30. 1920.

Sometimes found with the typical form.

RANUNCULUS REPENS L. See Rh. **21**: 169. 1919. Creeping Buttercup.

Low wet woods and open ground. Circumneutral. Local: St. Louis Co.

RANUNCULUS PARVIFLORUS L.

Swampy woods and open ground. Oxylophile. Southeastern Mo.: Butler and Dunklin counties.

RANUNCULUS ACRIS L. Meadow Buttercup.

Meadows and waste ground. Circumneutral. Introduced in St. Louis and Jackson counties.

Myosurus minimus L. Mouse-tail.

Low open woods and moist fields. Circumneutral. General.

Trautvetteria carolinensis (Walt.) Vail. False Bugbane.

Moist limestone bluffs. Calciphile. Rare and local: Shannon Co.

Thalictrum dioicum L. Early Meadow Rue.

Rich rocky woods and ledges along shaded bluffs. Circumneutral to calciphile. General, but scattered: Adair, St. Louis, Jefferson, Franklin, Carter, Reynolds, Shannon, Oregon, Howell, Morgan, Jackson, Benton, and Stone counties.

Thalictrum dasycarpum Fisch. & Lall. Meadow Rue.

Rich or rocky woods, and moist open ground. Circumneutral. General.

Thalictrum revolutum DC.

Rich or rocky woods. Circumneutral. General but less common than the last species.

Anemonella thalictroides (L.) Spach. Rue Anemone.

Rich or rocky woods. Circumneutral. General.

Hepatica americana (DC.) Ker. See Rh. **19**: 45. 1927. Hepatica, Liver-leaf.

Hepatica triloba of Am. auth., not Chaix. (G).

Hepatica Hepatica (L.) Karst. (B & B).

Rocky hillside woods and bluffs. Oxylophile to circumneutral. Southern Mo.; Iron, Reynolds, Dent, Shannon, Oregon, Howell, Texas, Wright, Douglas, Ozark, Webster, Greene, Christian, Taney, Stone, and Barry counties.

Hepatica americana f. **candida** Fernald, Rh. **19**: 46. 1917.

Commonly found throughout the range of the typical form in Missouri.

Hepatica acutiloba DC. Hepatica, Liver-leaf.

Rocky hillside woods and bluffs. Calciphile to circumneutral. Eastern and middle Missouri: Schuyler, Adair, Clark, Marion, Pike, Boone, Callaway, Warren, Montgomery, St. Charles, St. Louis, Jefferson, Franklin, Crawford, Washington, St. Francois, Ste. Genevieve, Perry, Bollinger, Cape Girardeau, Iron, Wayne, Carter, Reynolds, and Shannon counties.

Hepatica acutiloba f. **albiflora** Hoffmann, Proc. Bost. Soc. Nat. Hist. **36**: 268. 1922.

Commonly found throughout the range of the typical form in Mo.

Hepatica acutiloba f. **rosea** Hoffmann, Proc. Bost. Soc. Nat. Hist. **36**: 268. 1922.

Commonly found throughout the range of the typical form in Mo.

Anemone caroliniana Walt. Prairie Anemone.

Prairies, meadows, glades, waste ground, and along roadsides. Circumneutral. Western and middle Mo.: Boone, Pulaski, Morgan, Dallas, Johnson, Henry, St. Clair, Cedar, Lawrence, Barry, Jackson, Cass, Bates, Vernon, Barton, Greene, Jasper, Newton, and McDonald counties.

Anemone cylindrica Gray. Thimbleweed.

Prairies and open woods. Circumneutral to calciphile. Northwestern and west-central Mo.: Atchinson, Nodaway, Holt, and Jackson counties.

Anemone virginiana L. Thimbleweed.

Prairies and open woods. Circumneutral. General.

Anemone virginiana f. leucosepala Fernald, Rh. **19**: 140. 1917.

In similar situations to the typical form. Found throughout the range of the species in Mo.

Anemone canadensis L. White Anemone.

Low open woods and meadows. Circumneutral. Northern, central, and eastern Mo., mainly near the larger rivers: Clark, Marion, St. Louis, Jefferson, Franklin, Ste. Genevieve, Madison, Butler, Boone, Saline, Atchison, Holt, Andrew, Platte, Clay, and Jackson counties.

Clematis virginiana L. Virgin's Bower.

Woods and thickets along streams. Circumneutral. General.

Clematis virginiana var. **missouriensis** (Rydb.) Palmer & Steyermark, comb. nov.

Clematis missouriensis Rydb. (G), (B & B).

Rocky woods and thickets along streams. Circumneutral. Central, southern, and western Mo.: Scott, Butler, Shannon, Maries, Cole, Saline, Gentry, Douglas, Greene, Christian, Taney, Stone, Barry, Jasper, and McDonald counties.

Clematis Viorna L. Leather Flower.

Rich woods and bluffs. Circumneutral. Southern Mo.: Bollinger and Taney counties.

Clematis versicolor Small.

Rocky woods and bluffs. Circumneutral. Southern Mo.: Oregon, Ozark, Taney, Greene, Stone, Barry, and McDonald counties.

Clematis Pitcheri T. & G. Leather Flower, Bluebell.

Viorna Pitcheri (T. & G.) Britton (B & B).

Thickets and rocky woods. Circumneutral to calciphile. General.

Clematis crispa L. Swamp Leather Flower.

Low wet woods and borders of swamps. Circumneutral. Southern Mo.: Scott, Mississippi, Pemiscot, Dunklin, Stoddard, Butler, Ripley, Ozark, and Newton counties.

Clematis Fremontii Wats.

Limestone glades. Calciphile. Eastern Mo., south of the Missouri River: St. Louis, Jefferson, Franklin, St. Francois, and Washington counties.

Isopyrum biternatum (Raf.) T. & G. False Rue Anemone.

Rich woods. Circumneutral to calciphile. General.

Aquilegia canadensis L. Wild Columbine.

Aquilegia coccinea Small (S).

Shaded rich woods, rocks and bluffs; usually on limestone. Calciphile to circumneutral. General.

Aquilegia canadensis var. **flaviflora** (Tenney) Britton.

Occasionally occurring with the species. Northwestern Mo., local: Buchanan Co.

Delphinium Ajacis L. Larkspur.

Commonly cultivated in old gardens and often escaping. General.

Delphinium tricorne Michx. Dwarf Larkspur.

Rocky woods and thickets. Circumneutral. General.

Delphinium Treleasei Bush. Glade Larkspur.

Glades and rocky slopes of bald knobs. Calciphile. Southwestern Mo.: Greene, Taney, Stone, and Barry counties.

Delphinium azureum Michx.

Rocky open woods, glades, and prairies. Calciphile to circumneutral. Central and southern Mo.: Franklin, Crawford, Dent. Shannon, Carter, Phelps, Pulaski, Maries, Cole, Texas, Howell, Laclede, Wright, Webster, Taney, Miller, Douglas, Ozark, Greene, and Barry counties. This species and *Delphinium Penardi* intergrade in color considerably.

Delphinium azureum var. **Nortonianum** (Mack. & Bush) Palmer & Steyermark, comb. nov.

Delphinium Nortonianum Mack. & Bush (G).

Rocky upland open woods, glades, and prairies. Oxylophile to circumneutral. Southern Mo.: Crawford, Carter, Shannon, Oregon, Texas, Howell, Douglas, Ozark, Stone, Taney, Wright, Barry, and McDonald counties. The characters upon which *Delphinium Nortonianum* were based have been found to merge with typical *Delphinium azureum* in certain degrees, and it appears best treated as a variety of the latter species.

Delphinium Penardi Huth. Prairie Larkspur.

Delphinium camporum Greene (B & B).

Rocky prairies and glades. Circumneutral. Northern, central, and southwestern Mo., apparently absent from much of the Ozark region and from the Southeastern lowlands: Clark, Adair, Macon, Linn, Ralls, Lincoln, St. Louis, Boone, Saline, Miller, Camden, Laclede, Dallas, Atchison, Grundy, Daviess, Caldwell, Jackson, Cass, Bates, Vernon, Henry, St. Clair, Greene, Webster, Stone, Dade, Lawrence, Barry, Jasper, Newton, and McDonald counties.

Cimicifuga racemosa (L.) Nutt. Bugbane, Black Snakeroot.

Rocky woods and bluffs. Circumneutral to oxylophile. East-central and southern Mo.: St. Louis, St. Francois, Bollinger, Madison, Dent, Iron, Wayne, Reynolds, Carter, Butler, Ripley, Oregon, Shannon, Howell, Texas, Wright, Webster, Greene, Douglas, Ozark, Stone, Barry, and Jasper counties.

Actaea brachypoda Ell. White Baneberry.

Actaea alba (L.) Mill. (G), (B & B).

Rich woods and banks of small streams. Circumneutral. Eastern, middle, and southern Mo., and locally in northwestern Mo.: Schuyler, Adair, Clark, Marion, Boone, Warren, St. Louis, Jefferson, Franklin, St. Francois, Perry, Scott, Stoddard, Shannon, Texas, Dent, Crawford, Phelps, Pulaski, Camden, Laclede, Atchison, Greene, and Barry counties.

Hydrastis canadensis L. Golden Seal.

Rich woods and thickets. Circumneutral. Central and southern Mo.: well distributed but nowhere common: St. Louis, Jefferson, Franklin, St. Francois, Iron, Bollinger, Dunklin, Ripley, Carter, Shannon, Texas, Phelps, Miller, Cole, Boone, Saline, Jackson, Johnson, Polk, Greene, Taney, Lawrence, Barry, and Jasper counties.

Fam. Magnoliaceae

Magnolia acuminata L. Cucumber Tree.

Low hills and rocky bluffs. Circumneutral. Southern Mo.: Cape Girardeau, Scott, Stoddard, Dunklin, Butler, and Ozark counties.

Magnolia acuminata var. **ozarkensis** Ashe, Jour. Elisha Mitchell Sci. Soc. **41**: 269. 1926.

Along rocky bluffs. Circumneutral. Southwestern Mo.: Barry Co.

Liriodendron Tulipifera L. Tulip Tree, Yellow Poplar.

Upland woods and along small streams. Circumneutral. Southeastern Mo.: Perry, Cape Girardeau, Bollinger, Scott, Mississippi, Dunklin, Stoddard, and Butler counties.

Fam. Annonaceae

Asimina triloba Dunal. Papaw.

Rich woods and along bluffs and streams. Circumneutral. General.

Fam. Menispermaceae

Cocculus carolinus (L.) DC. Fishberry.

Rocky woods and thickets. Circumneutral. Southern Mo., and locally northward along the large rivers: Marion, Ralls, Cole, Iron, Reynolds, Wayne, Mississippi, Dunklin, Ripley, Oregon, Shannon, Howell, Ozark, Douglas, Taney, Stone, Barry, Greene, Cedar, Vernon, Barton, Jasper, Newton, and McDonald counties.

Menispermum canadense L. Moonseed, Yellow-root.

Moist woods and thickets. Circumneutral. General.

Calycocarpum Lyoni (Pursh) Nutt. Cup-seed.

Thickets and low alluvial fields. Circumneutral. East-central and southern Mo.: St. Louis, Jefferson, Franklin, Madison, Scott, Mississippi, Stoddard, Dunklin, Ripley, Carter, Oregon, Dent, Shannon, Pulaski, Douglas, Ozark, Taney, Stone, Cedar, Barry, Jasper, Newton, and McDonald counties.

Fam. Berberidaceae

Podophyllum peltatum L. May Apple, Mandrake.

Open woods and thickets. Circumneutral to calciphile. General.

Caulophyllum thalictroides (L.) Michx. Blue Cohosh.

Rich woods and moist banks along bluffs. Circumneutral to calciphile. General but uncommon: Mercer, Schuyler, Marion, Boone, Warren, St. Louis, Jefferson, Franklin, Shannon, Texas, Howell, Phelps, Pulaski, Camden, Laclede, Ozark, Greene, Clay, Jackson, and Jasper counties.

Berberis canadensis Mill. American Barberry.

Rocky woods and bluffs, on limestone and sandstone. Oxylophile. Southeastern Mo., local: Shannon, Texas, and Howell counties.

Berberis vulgaris L. European Barberry.

Cultivated and rarely escaped into pastures and open woods. Clark and Marion Counties.

BERBERIS THUNBERGII DC. Japanese Barberry.

Cultivated and rarely escaped into open woods and open ground. Marion Co.

Fam. LAURACEAE

Sassafras officinale Nees & Eberm. Sassafras.

Sassafras variifolium (Salisb.) Ktze. (G).

Sassafras Sassafras (L.) Karst. (B & B).

Borders of woods and thickets, dry or sterile soil. Oxylophile to circumneutral. Eastern, central, and southern Mo.; south of a line drawn from Marion to Lafayette and Cass counties.

Sassafras officinale var. **albidum** (Nutt.) Blake, Rh. **20**: 99. 1918.

Similar situations and range to those of the typical form, but less common.

Benzoin aestivale (L.) Nees. Spice Bush.

Woods and thickets, in moist alluvial or rocky soil. Circumneutral. Central and southern Mo.; commonest in the Ozark region.

Benzoin aestivale var. **pubescens** Palmer & Steyermark, var. nov.

Similar situations to the last. Circumneutral. Central and southern Mo.: Montgomery, St. Louis, Jefferson, New Madrid, Stoddard, Iron, Shannon, Dent. Ozark, Moniteau, Morgan, Hickory, Stone, Jasper, Newton, and McDonald counties.

A typo recedit ramulis annotinis pubescentibus; foliis subtus ad nervos petiolosque pubescentibus margine ciliatis.

Differs from the typical form in the pubescent young branchlets and in the leaves, which are more or less pubescent, at least along the veins beneath, ciliate on the margins, and with pubescent petioles.

South Carolina, Georgia, Alabama, Mississippi, Louisiana, Tennessee, Kentucky, southern Illinois, and central and southern Missouri, to southeastern Kansas, Oklahoma, and eastern Texas. The occurrence of this undescribed pubescent variety throughout a large area has been the cause of considerable confusion and has been responsible for the wide range given in manuals to *Benzoin melissaefolium* (Walt.) Nees, which has been credited to Missouri, but which appears to be a rare species confined to the coastal plain and Piedmont regions of the southeastern states.

MISSOURI: Alba, Jasper Co., Sept. 12, 1922, *E. J. Palmer 21923* (Arn. Arb. TYPE).

Fam. PAPAVERACEAE

Sanguinaria canadensis L. Bloodroot.

Rocky woods and moist rich ground along bluffs. Circumneutral to calciphile. General.

Sanguinaria canadensis var. **rotundifolia** (Greene) Fedde.

Wooded hillsides and bluffs along the Missouri River. Circumneutral to calciphile. Northwestern Mo., local: Atchison Co.

CHELIDONIUM MAJUS L. Celandine.

Introduced in waste ground. Jackson Co.

Stylophorum diphyllum (Michx.) Nutt. Celandine Poppy.

Rocky woods, rich ground, and bluffs. Circumneutral. East-central and southern Mo., mostly in the eastern Ozark region: Warren, St. Charles, St. Louis, Jefferson, Washington, St. Francois, Madison, Stoddard, Wayne, Carter, Shannon, and Taney counties.

Argemone intermedia Sweet. Prickly Poppy.

Open ground. Oxylophile to circumneutral. Central and southern Mo., scattered: St. Louis, Dunklin, Butler, Jackson, and Greene counties. Introduced except perhaps in southeastern lowlands.

Argemone alba Lestiboudois.

Waste and open ground. Indifferent. Southeastern Mo.: Butler Co., and also introduced in Jackson Co.

Argemone mexicana L. Mexican Poppy.

Waste open ground and along railroads. Introduced in Knox, Phelps, Jackson, and Jasper counties.

PAPAVER DUBIUM L. Blind Eyes.

Waste ground. Escaped from cultivation in Adair and Jackson counties.

PAPAVER RHOEAS L. Corn Poppy.

Waste ground. Escaped in Adair and Cole counties.

PAPAVER SOMNIFERUM L. Common Poppy.

Cultivated in gardens and escaped into waste ground: Jackson Co., and also recorded from Greene Co.

Fam. FUMARIACEAE

Dicentra Cucullaria (L.) Bernh. Dutchman's Breeches.

Rich woods and moist rocky ground along bluffs. Circumneutral to calciphile. General.

Dicentra canadensis (Goldie) Walp. Squirrel Corn.

Rich banks and along shaded bluffs. Circumneutral. Rare. Northern and central Mo.: Marion, Warren, St. Louis, Jefferson, Boone, and Jackson counties.

Corydalis flavula (Raf.) DC.

Rich woods and moist rocky banks or ledges along bluffs. Circumneutral. General.

Corydalis micrantha (Engelm.) Gray.

Rich woods, and along open or shaded banks and bluffs. Circumneutral. Western Mo.: Miller, Platte, Clay, Jackson, Henry, Webster, Wright, Stone, Jasper, Newton, and McDonald counties.

Corydalis crystallina Engelm.

Open woods, prairies, and barrens. Circumneutral. Western Mo.: Livingston, Pettis, Cass, Bates, Vernon, Henry, St. Clair, Greene, Lawrence, Jasper, Newton, and McDonald counties.

Corydalis campestris (Britton) Buchholz & Palmer, Trans. Acad. Sci. St. Louis **25**: 115. 1926.

Capnoides campestre Britton (B & B).

Rocky woods. Circumneutral. Southwestern Mo.: McDonald Co.

Corydalis aurea Willd.

Open or rocky woods, prairies, glades, fallow fields, ledges, and roadsides. Calciphile to circumneutral. General: Livingston, Grundy, Daviess, Adair, Ralls, St. Louis, Jefferson, Ste. Genevieve, Mississippi, Dunklin, Wayne, Carter, Phelps, Texas, Camden, Saline, Randolph, Wright, Polk, Clay, Jackson, Cass, Vernon, Greene, Jasper, and McDonald counties.

Corydalis aurea var. **occidentalis** Engelm.

Corydalis montanum (Engelm.) Britton (B & B).

Open or rocky woods, glades, and prairies. Circumneutral. Central and southern Mo.: St. Louis, Jefferson, Madison, Gasconade, Boone, Phelps, Crawford, Pulaski, Moniteau, Henry, St. Clair, Cedar, Jackson, and Jasper counties.

Fam. Cruciferae

Draba verna L. Whitlow Grass.

Fields and waste ground. Circumneutral. Eastern and middle Mo., scattered: Marion, St. Louis, Boone, and Cole counties.

Draba reptans (Lam.) Fernald, Rh. **36**: 368. 1934.

Draba caroliniana Walt. (G), (B & B).

Fields, glades, rocky ledges, and waste ground. Circumneutral to oxylophile; frequently on sandstone or cherty soils. General.

Draba reptans var. **micrantha** (Nutt.) Fernald, Rh. **36**: 368. 1934.

Draba caroliniana var. *micrantha* (Nutt.) Gray (G).

Sandy bottoms and rocky glades. Oxylophile to circumneutral. Local: Jackson Co.

Draba cuneifolia Nutt.

Rocky open woods, glades, and rocky ledges. Calciphile to circumneutral. Central and southern Mo., south of a line drawn from Ralls and Boone counties to Jackson Co.

Draba brachycarpa Nutt.

Prairies, cultivated and fallow fields, and low open ground or glades. Circumneutral. Central and southern Mo. south of a line drawn from St. Charles, Audrain, and Randolph counties to Jackson Co.

Berteroa incana (L.) DC. Hoary Alyssum.

Dry open ground. Circumneutral. Introduced in Greene Co.

Lesquerella gracilis (Hook.) Wats. Slender Bladder-pod.

Glades and rocky open woods. Calciphile. Southwestern Mo.: Greene, Dade, Lawrence, and Jasper counties, and also introduced in Bollinger Co.

Lesquerella angustifolia (Nutt.) Wats.

Glades and barrens. Calciphile. Southwestern Mo., local: Greene Co.

Thlaspi arvense L. Penny Cress.

Waste ground, and along roadsides and railroads. Indifferent. Northern and central Mo., and perhaps more general: Macon, St. Charles, St. Louis, Jefferson, Franklin, Boone, Cooper, Chariton, Carroll, Gentry, Daviess, Atchison, Nodaway, and Jackson counties.

Thlaspi perfoliatum L.

Along rocky stream bed. Introduced in Jefferson Co.

Lepidium virginicum L. Tonguegrass, Peppergrass.
Lepidium texanum Buckl. (R).
Fields, roadsides, and waste ground. Indifferent. General and common.

LEPIDIUM DENSIFLORUM Schrad.
Lepidium neglectum Thell.
Lepidium apetalum of auth., not Willd. (G).
Fields, waste ground, and about dwellings. Indifferent. General but scattered.

LEPIDIUM PERFOLIATUM L.
Waste ground and along railroads and roadsides. Indifferent. Scattered: St. Louis, Madison, and Jackson counties.

LEPIDIUM CAMPESTRE (L.) R. Br.
Waste ground and along railroads. Indifferent. Northern, central, and eastern Mo., and occasional elsewhere: Adair, Knox, Ralls, Pike, Lincoln, St. Charles, St. Louis, Franklin, Madison, Iron, Laclede, Livingston, Carroll, Daviess, and Jackson counties.

LEPIDIUM DRABA L.
Waste ground. Circumneutral. Introduced in St. Louis Co.

CORONOPUS DIDYMUS (L.) Sm.
Waste ground. Indifferent. Southeastern Mo.: Dunklin and Butler counties.

CAPSELLA BURSA-PASTORIS (L.) Medic. Shepherd's Purse.
Fields, roadsides, waste ground, and about dwellings. Indifferent. General and common.

CAMELINA SATIVA (L.) Crantz. False Flax.
Waste ground and along railroads. Indifferent. Scattered: St. Louis and Jackson counties.

CAMELINA MICROCARPA Andrz.
Similar situations to the preceding and more common. Indifferent. General but scattered: St. Louis, Jefferson, Franklin, Iron, Cole, Clay, Jackson, Lawrence, and Jasper counties.

RAPHANUS SATIVUS L. Radish.
Introduced in fields and waste ground. Indifferent. Scattered: Boone and Jackson counties.

ERUCA SATIVA Mill. Garden Rocket.
Introduced along railroads. Indifferent. Scattered: Clark and Jackson counties.

ERUCASTRUM POLLICHII Spenner.
Waste ground. Indifferent. Introduced in Jackson Co.

BRASSICA ALBA (L.) Boiss. White Mustard.
Fields and waste ground. Indifferent. General.

BRASSICA ARVENSIS (L.) Ktze. Charlock.
Fields, roadsides, and waste ground. Indifferent. General.

BRASSICA JUNCEA (L.) Cosson. Indian Mustard.
Fields and waste ground. Indifferent. General.

BRASSICA JAPONICA Siebold. Curled Mustard.

Fields and waste ground. Indifferent. General but scattered: Pike, St. Louis, Boone, Jackson, and Jasper counties.

BRASSICA NIGRA (L.) Koch. Black Mustard.

Fields, waste ground, and roadsides. Indifferent. General.

BRASSICA CAMPESTRIS L. Rutabaga.

Open and waste ground. Indifferent. General.

CONRINGIA ORIENTALIS (L.) Dumort. Hare's-ear Mustard.

Waste ground and along roadsides and railroads. Indifferent. Scattered: St. Louis, Jefferson, St. Francois, Iron, Randolph, Boone, Daviess, Clay, and Jackson counties.

SISYMBRIUM OFFICINALE (L.) Scop. Hedge Mustard.

Fields, waste ground, and along railroads. Indifferent. General.

SISYMBRIUM OFFICINALE var. LEIOCARPUM DC.

Frequently found with the typical form.

SISYMBRIUM ALTISSIMUM L. Tumble Mustard.

Fields, waste ground, and along railroads. Indifferent. General.

DESCURAINIA SOPHIA (L.) Wetts.

Sisymbrium Sophia L. (G).

Sophia Sophia (L.) Britton (B & B).

Prairie banks and waste ground. Circumneutral. Western Mo.: Jackson and Nodaway counties.

Descurainia intermedia (Rydb.) Daniels. Tansy Mustard.

Sisymbrium canescens Nutt. var. *brachycarpon* (Richards.) Wats. (G).

Sophia brachycarpa (Richards.) Rydb. (R).

Sophia pinnata (Walt.) Howell (B & B), in part.

Glades, open banks, and prairies, roadsides, and dry rocky ledges along bluffs. Calciphile to circumneutral. General. This and the previous species have sometimes been confused with *Descurainia incisa (Sisymbrium incisum)* and *Descurainia canescens (Sisymbrium canescens)* which are not known to occur in Mo.

ARABIDOPSIS THALIANA (L.) Heynh. Mouse-ear Cress.

Sisymbrium Thalianum (L.) J. Gay (G).

Rocky or alluvial open ground and fields. Circumneutral. East-central and southern Mo., scattered: Callaway, St. Louis, Ste. Genevieve, Cape Girardeau, Stoddard, Pemiscot, and Ozark counties.

ERYSIMUM REPANDUM L.

Fields, waste ground, and along railroads. Indifferent. Central Mo., scattered: Jefferson, Franklin, Cole, Montgomery, Boone, and Jackson counties.

Erysimum asperum DC. Western Wall-flower.

Erysimum arkansanum Nutt.

Glades and along rocky bluffs. Calciphile. Central and southern Mo.: St. Charles, St. Louis, Jefferson, Franklin, Osage, Maries, Miller, Camden, Benton, Cooper, Jackson, and Taney counties.

Erysimum cheiranthoides L. Worm-seed Mustard.

Fields and waste ground. Circumneutral. Scattered: Clark, St. Louis, Pulaski, and Jackson counties.

Roripa Nasturtium-aquaticum (L.) Schinz & Thell. Fl. Schweiz, ed. 3, 240. 1909. Water Cress.

Radicula Nasturtium-aquaticum (L.) Britten & Rendle (G).

Sisymbrium Nasturtium-aquaticum L. (B & B).

In springs and clear running water. Calciphile to circumneutral. Abundant in central and southern Mo., and perhaps found throughout the state.

Roripa sinuata (Nutt.) Hitchc.

Radicula sinuata (Nutt.) Greene (G), (B & B).

Low open ground and alluvial banks of streams. Circumneutral. General but scattered: Marion, Ralls, St. Louis, Jefferson, Perry, Pemiscot, Camden, Boone, Cooper, Daviess, Atchison, Clay, and Jackson counties.

Roripa sessiliflora (Nutt.) Hitchc.

Radicula sessiliflora (Nutt.) Greene (G), (B & B).

Wet open woods and borders of sloughs, ponds, and streams. Circumneutral. General.

RORIPA SYLVESTRIS (L.) Bess. Yellow Cress.

Radicula sylvestris (L.) Druce (G), (B & B).

Wet meadows and banks of streams. Circumneutral. Scattered: St. Louis, Boone, Stone, and McDonald counties.

Roripa obtusa (Nutt.) Britton.

Radicula obtusa (Nutt.) Greene (G), (B & B).

Wet woods and borders of sloughs, ponds, and ditches. Circumneutral. General.

Roripa hispida (Desv.) Britton. See Rh. **30**: 131. 1928. Marsh Water Cress.

Radicula palustris var. *hispida* (Desv.) Robinson (G).

Alluvial flats along the Mississippi River. Circumneutral. Local: Perry Co.

Roripa hispida var. **glabrata** Lunell. See Rh. **30**: 133. 1928. Marsh Water Cress.

Radicula palustris of Am. auth., not Moench (G), (B & B).

Wet woods, borders of sloughs and ponds, and alluvial soils of streams and rivers. Circumneutral. General.

Roripa aquatica (Eat.) Palmer & Steyermark, comb. nov. Lake Cress.

Radicula aquatica (Eat.) Robinson (G).

Neobeckia aquatica (Eat.) Britton (B & B).

Sloughs and swampy woods. Circumneutral. Southern Mo., scattered: St. Louis, Jefferson, Ripley, Phelps, and Jasper counties.

RORIPA ARMORACIA (L.) Hitchc. Horseradish.

Radicula Armoracia (L.) Robinson (G).

Armoracia Armoracia (L.) Britton (B & B).

Cultivated and occasionally escaped into fields and waste ground. Indifferent. Scattered: Boone, Jackson, and Taney counties.

Barbarea vulgaris R. Br. Yellow Rocket, Winter Cress.

Wet fields, moist meadows, and alluvial ground. Circumneutral. General.

Barbarea vulgaris var. **longisiliquosa** Carion. See Rh. **11**: 139. 1909.

Barbarea stricta of auth. in part, not Andrz. (G), (B & B).

Moist meadows and alluvial ground. Circumneutral. Western Mo., local: Jackson Co. This has sometimes been confused with the preceding variety.

Selenia aurea Nutt.

Rocky prairies, chert, sandstone and leached limestone glades, sandy fields, and roadsides. Oxylophile. Southwestern Mo.: Benton, Polk, Webster, Greene, St. Clair, Cedar, Lawrence, Vernon, Jasper, and Newton counties.

Iodanthus pinnatifidus (Michx.) Steud. Purple Rocket.

Wet woods and moist alluvial thickets. Circumneutral. General.

Leavenworthia uniflora (Michx.)Britton.

Wet rocky ledges and depressions in glades. Calciphile. East-central and southern Mo.: St. Louis, Franklin, Jefferson, St. Francois, Washington, Crawford, Madison, Shannon, Maries, Gasconade, Montgomery, Phelps, Pulaski, Laclede, Miller, Camden, Dallas, Polk, Wright, Webster, Douglas, Taney, Stone, and Barry counties.

Dentaria laciniata Muhl. Toothwort, Pepper-root.

Rich or rocky woods. Circumneutral. General.

Dentaria laciniata var. **integra** (Schulz) Fernald.

Similar situations to the typical form. Circumneutral. Scattered throughout the range of the typical form.

Cardamine bulbosa (Schreb.) BSP. Spring Cress.

Wet woods and meadows, and along wet sandstone cliffs. Circumneutral to oxylophile. Eastern, central, and southern Mo., south of a line drawn from St. Louis, Montgomery, Audrain, and Randolph, to Camden and Jackson counties.

Cardamine pennsylvanica Muhl.

Wet woods, bogs, and springy ground. Circumneutral. General.

Cardamine parviflora L. var. **arenicola** (Britton) O. E. Schulz. See Rh. **29**: 192. 1927.

Cardamine parviflora of Am. auth., not L. (G), (B & B), in part.

Cardamine arenicola Britton (B & B), in part.

Wet open woods, fields, wet rocky ledges, and depressions in glades. Circumneutral to oxylophile. General.

Cardamine Douglassii (Torr.) Britton. Spring Cress.

Alluvial and moist woods. Circumneutral. Eastern and northern Mo.: Adair, Knox, Shelby, Chariton, and Cape Girardeau counties.

Arabis lyrata L. Rock Cress.

Rocky bluffs or ledges, on limestone or sandstone. Calciphile to circumneutral. Eastern Mo., south of the Missouri River: St. Louis, Jefferson, Washington, Crawford, Shannon, and Texas counties.

Arabis dentata T. & G.

Rich woods, moist rocky ledges, and borders of streams. Circumneutral. Central and southern Mo.: Boone, Warren, St. Louis, Jefferson, Franklin, Washington, St. Francois, Ste. Genevieve, Scott, Stoddard, Shannon, Camden, Texas, Laclede, Morgan, Polk, Saline, Jackson, Benton, St. Clair, Wright, Douglas, Taney, Stone, and Jasper counties.

Arabis virginica (L.) Poir. See Rh. **29**: 192. 1927.

Open alluvial ground, fallow fields, and waste ground. Circumneutral to oxylophile. Central and southern Mo., south of a line drawn from Ralls and Chariton counties to Jackson Co.

Arabis hirsuta (L.) Scop.

Rocky ledges and bluffs, usually on limestone. Calciphile to circumneutral. Eastern, central, and southern Mo., but apparently absent from much of the Ozark region: Clark, Lewis, Marion, Ralls, Boone, St. Louis, Jefferson, Franklin, Washington, Cape Girardeau, Carter, Shannon, Oregon, Webster, Christian, Taney, Stone, Jackson, Jasper, Newton, and McDonald counties.

Arabis viridis Harger, Rh. **13**: 38. 1911.

Dry rocky woods, rocky open ground and bluffs. Oxylophile. Southern and east-central Mo.: Ste. Genevieve, Madison, Wayne, Stoddard, Ripley, Carter, Iron, Washington, Franklin, Crawford, Dent, Reynolds, Oregon, Shannon, Texas, Phelps, Pulaski, Douglas, Stone, Ozark, Jasper, Newton, and McDonald counties. This species has previously been confused with *Arabis Drummondii*, *A. patens*, *A. brachycarpa*, and *A. glabra*, none of which occur in Missouri, and has also been confused with *A. laevigata*.

Arabis laevigata (Muhl.) Poir.

Rich woods, along base of bluffs, alluvial ground along streams, and along bluffs and ledges. Circumneutral. Eastern, central, and Southern Mo., east and south of a line drawn from Marion, Shelby, Boone, and Henry counties to Vernon Co., and locally northwest in Platte Co.

Arabis canadensis L. Sickle-pod.

Rocky woods and bluffs. Circumneutral. General.

Fam. Capparidaceae

Polanisia graveolens Raf. Clammy-weed.

Rocky open ground, waste ground, and gravel bars along streams. Circumneutral to oxylophile. General but not common.

Polanisia trachysperma T. & G.

In similar situations to the preceding. Circumneutral. Southwestern Mo.: Greene, Taney, Stone, Barry, and McDonald counties.

Cleome serrulata Pursh. Rocky Mountain Bee-plant.

Loess hills and waste ground. Circumneutral. Northwestern Mo., and introduced in central Mo.: Atchison, Jackson, and St. Louis counties.

CLEOME SPINOSA L. Spider-flower.

Cultivated in gardens and sometimes escaped into waste ground. Indifferent. Scattered: St. Louis, Pemiscot, Dunklin, Taney, Stone, Barry, and Jasper counties.

Fam. Crassulaceae

Penthorum sedoides L. Ditch Stonecrop.

Low wet woods, swamps, and along sloughs and ditches. Circumneutral. General.

Sedum Nuttallianum Raf. Yellow-flowered Stonecrop.

Chert glades. Oxylophile to circumneutral. Southwestern Mo., local: Jasper and Newton counties.

Sedum pulchellum Michx. Widow's Cross.

Glades, rocky ledges, and bluffs. Calciphile to circumneutral; most frequently on limestone, but also found on granitic and siliceous rocks. Central and southern Mo., but commonest in the western Ozark region: Moniteau, Boone, Lincoln, Oregon, Texas, Dallas, Polk, Greene, Wright, Webster, Christian, Stone, Jackson, Cass, Henry, St. Clair, Cedar, Dade, Lawrence, Barry, Jasper, Newton, and McDonald counties. This has been confused with the eastern *Sedum Nevii* which is not known in Mo.

Sedum ternatum Michx.

Rocky ledges and glades. Calciphile to circumneutral. Scattered: Marion, Greene, and Barry counties.

SEDUM TRIPHYLLUM (Haw.) S. F. Gray. See Rh. **11**: 46. 1909. Live-forever, Orpine.

Sedum purpureum Tausch (G).

Planted in old gardens and escaped to roadsides and waste ground. Indifferent. Scattered: Clark, Scotland, Marion, St. Louis, Boone, and Jasper counties.

Fam. SAXIFRAGACEAE

Sullivantia renifolia Rosendahl, Univ. Minn. Studies Biol. Sci. 6: 410, *pl. 43.* 1927.

Sullivantia Sullivantii of auth., not (T. & G.) Britton (G), (B & B).

On moist shaded bluffs of St. Peter sandstone. Oxylophile. East-central Mo., local: Warren and Jefferson counties.

Saxifraga pensylvanica L. var. **Forbesii** (Vasey) Engl. & Irmsch. Pflanzenreich 4, Fam. 117, **1**: 66. 1916.

Saxifraga Forbesii Vasey (G).

Micranthes pennsylvanica (L.) Haw., in part (B & B).

Moist shaded sandstone bluffs. Oxylophile. East-central Mo.: Montgomery, Warren, Lincoln, St. Charles, St. Louis, and Jefferson counties.

Saxifraga virginiensis Michx. Early Saxifrage.

Micranthes virginiensis (Michx.) Small (B & B).

Moist ledges along bluffs; on sandstone or granitic rocks. Oxylophile. East-central Mo., and southern Mo., in the eastern Ozark region: St. Louis, Jefferson, Ste. Genevieve, Madison, Iron, Phelps, Texas, and Douglas counties.

Saxifraga texana Buckley.

Micranthes texana (Buckl.) Small.

Rocky prairies and glades. Oxylophile. Southwestern Mo.: Polk, Greene, St. Clair, Cedar, Vernon, Barton, Jasper, and Newton counties.

Heuchera americana L. Alum Root.

Rocky open woods. Oxylophile to circumneutral. Southern and east-central Mo.: Jefferson, Washington, Madison, Iron, Dunklin, Butler, Ozark, Jasper, and Jackson counties.

Heuchera hirsuticaulis (Wheelock) Rydb.

Rocky bluffs and banks. Circumneutral. Southern Mo., mostly in the eastern Ozark region: Jefferson, Washington, Cape Girardeau, Iron, Madison, Reynolds, Carter, Oregon, Shannon, Dent, Pulaski, Camden, and Taney counties.

Heuchera Richardsonii R. Br. var. **Grayana** Rosendahl, Butters & Lakela, Rh. **35**: 117. 1933.

Heuchera hispida of auth., not Pursh (G), (B & B).

Open rocky woods, prairies, and along bluffs and embankments. Circumneutral. General. This is the common species in Mo., and it has frequently been confused with *H. hirsuticaulis.*

Heuchera puberula Mack. & Bush.

Heuchera parviflora of auth., not Bartl. (G), (B & B).

Shaded limestone bluffs. Calciphile. Southern Mo.: Ste. Genevieve, Ripley, Carter, Shannon, Oregon, Texas, Howell, Ozark, and Douglas counties.

Heuchera villosa Michx.

Shaded limestone bluffs. Calciphile. Southeastern Mo.: Iron Co.

Heuchera macrorhiza Small.

Shaded limestone bluffs. Calciphile. Southeastern Mo.: Iron Co.

Mitella diphylla L. Miterwort.

Moist shaded bluffs; on limestone or sandstone. Calciphile to circumneutral. East-central and southeastern Mo.: Montgomery, Warren, St. Charles, Jefferson, Perry, Ripley, Oregon, Howell, and Texas counties.

Parnassia grandifolia DC. Grass of Parnassus.

Moist limestone bluffs and moist rocky or boggy ground along streams. Circumneutral to calciphile. Southern Mo., rare and scattered: Washington, Shannon, Texas, Douglas, and Ozark counties.

Hydrangea arborescens L. Wild Hydrangea.

Shaded rocky banks and bluffs. Circumneutral; often on limestone but also found on siliceous and granitic rocks. Central and southern Mo. Common in the Ozark region.

Hydrangea arborescens f. **grandiflora** Rehder.

Rarely found with the typical form. Stoddard Co.

Hydrangea arborescens var. **Deamii** St. John, Rh. **23**: 208. 1922.

Similar situations to the typical form. Scattered in southern Mo.: Bollinger, Shannon, Phelps, Pulaski, Dallas, Hickory, and Newton counties.

Hydrangea arborescens var. **Deamii** f. **acarpa** St. John, Rh. **23**: 208. 1902.

Hydrangea cinerea f. *sterilis* Rehder.

Rarely found with the typical form. Shannon Co.

Hydrangea arborescens var. **oblonga** T. & G.

In similar situations to the typical form. East-central and southern Mo.: St. Louis, Cape Girardeau, Reynolds, Shannon, Ozark, and Barry counties.

Hydrangea arborescens var. **oblonga** f. **sterilis** St. John, Rh. **23**: 208. 1922.

Rarely found with the typical form. Ozark Co.

Itea virginica L. Virginia Willow.

Swamps, borders of bayous, and low wet woods. Circumneutral. Southeast-

ern Mo., in the lowlands: Cape Girardeau, Bollinger, New Madrid, Dunklin, and Butler counties.

Ribes Cynosbati L. Prickly Gooseberry.

Rocky woods and bluffs. Circumneutral. Eastern and southern Mo.: Clark, Lewis, Gasconade, St. Louis, Jefferson, Perry, Cape Girardeau, Scott, Stoddard, Oregon, Shannon, Dent, Texas, Howell, Polk, and Stone counties.

Ribes missouriense Nutt. Wild Gooseberry.

Ribes gracile Michx. (G).

Grossularia missouriensis (Nutt.) Coville & Britton (B & B).

Rocky open woods and bluffs. Circumneutral to calciphile. General.

Ribes odoratum Wendl. See Rh. **11**: 47. 1909. Flowering Currant.

Ribes aureum of auth., not Pursh (G).

Along high rocky bluffs of White River and its tributaries. Calciphile. Southwestern Mo.: Taney, Stone, and Barry counties.

Fam. Hamamelidaceae

Hamamelis virginiana L. Witch-hazel.

Rocky woods and low ground along streams. Oxylophile to circumneutral. Southeastern Mo., in the Iron Mountain sub-region: Iron, Shannon, and Reynolds counties.

Hamamelis vernalis Sarg. Trees & Shrubs **2**: 137, *pl. 156*. 1911. Ozark Witch-hazel.

Margins and gravel bars of rocky streams. Circumneutral. Southern Mo.: Franklin, Washington, St. Francois, Ste. Genevieve, Bollinger, Stoddard, Madison, Iron, Reynolds, Wayne, Carter, Ripley, Oregon, Shannon, Texas, Phelps, Pulaski, Dallas, Douglas, Ozark, Christian, Taney, Stone, and Barry counties.

Hamamelis vernalis f. **tomentella** Rehder, Jour. Arnold Arb. **1**: 256. 1920.

Sometimes found with the typical form. Taney and Barry counties.

Hamamelis vernalis f. **carnea** Rehder, Jour. Arnold Arb. **9**: 30. 1928.

Occasionally found with the typical form. Iron and Madison counties.

Liquidambar Styraciflua L. Sweet Gum.

Low woods and along streams. Oxylophile to circumneutral. Southeastern Mo., in the lowlands: Perry, Cape Girardeau, Bollinger, Madison, Scott, Mississippi, New Madrid, Pemiscot, Dunklin, Stoddard, Butler, Wayne, Ripley, and Oregon counties.

Fam. Platanaceae

Platanus occidentalis L. Sycamore.

Woods along streams. Circumneutral. General and probably in every county.

Platanus occidentalis var. **glabrata** (Fernald) Sarg. Bot. Gaz. **67**: 230. 1919.

Occasionally found with the typical form. Madison and Jasper counties.

Platanus occidentalis f. **attenuata** Sarg. Bot. Gaz. **67**: 229. 1919.

Occasionally found with the typical form. Shannon and Jasper counties.

Fam. ROSACEAE

Physocarpus opulifolius (L.) Maxim var. **intermedius** (Rydb) Robinson. Nine-bark.

Thickets, and rocky banks and bluffs of streams. Circumneutral. Eastern, central, and southern Mo.; commonest in the Ozark region.

Spiraea alba Du Roi. Meadow-sweet.

Spiraea salicifolia of auth. in part, not L. (G).

Moist meadows and open ground along streams. Oxylophile to circumneutral. Rare. Northern Mo.: Grundy Co., and also reported from Harrison Co.

Spiraea tomentosa L. var. **rosea** (Raf.) Fernald, Rh. **14**: 190. 1912. Hardhack.

Rocky and sandy open ground. Oxylophile. Southeastern Mo., local: Dunklin Co.

Aruncus sylvester Kostel. Goat's Beard.

Rocky or moist woods, and along base of bluffs. Circumneutral. Eastern, central, and southern Mo., south and east of a line drawn from Lewis, Montgomery, Saline, Benton, and Greene counties to McDonald Co.

Gillenia stipulata (Muhl.) Trelease. American Ipecac.

Rocky woods. Circumneutral to oxylophile. Eastern, central, and southern Mo.; commonest in the Ozark region.

PYRUS COMMUNIS L. Pear.

Planted and sometimes escaped in thickets. Scattered: St. Louis, Boone, and Jasper counties.

MALUS PUMILA Mill. Apple.

Pyrus Malus L. (G).

Malus Malus (L.) Britton (B & B).

Cultivated and escaped, in thickets, pastures, and waste ground. Scattered: St. Louis, Boone, Jackson, and Jasper counties.

Malus ioensis (Wood) Bailey. Wild Crab-apple.

Pyrus ioensis (Wood) Britton (G).

Thickets along small streams, pastures, and borders of woods. Circumneutral to calciphile. General, but commonest in northern Mo.

Malus ioensis var. **Palmeri** Rehder in Sarg. Trees & Shrubs **2**: 142. 1911.

Thickets and woods along small streams. Circumneutral. General, but commonest in the Ozark region.

Malus ioensis var. **Bushii** Rehder in Sarg. Trees & Shrubs **2**: 232. 1913.

Open woods. Circumneutral. Southeastern Mo.: Shannon, Wayne, and Dunklin counties.

Malus ioensis var. **spinosa** Rehder in Sarg. Trees & Shrubs **2**: 231. 1913.

Open woods and thickets. Circumneutral. Southeastern Mo.: Dunklin and Oregon counties.

Malus lancifolia Rehder in Sarg. Trees & Shrubs **2**: 141. 1911.

Open woods and thickets. Circumneutral. Central and southern Mo.: St. Francois, Iron, Bollinger, Wayne, Boone, and Jackson counties.

Malus coronaria (L.) Mill. American Crab.

Pyrus coronaria L. (G).

Thickets along streams. Circumneutral to calciphile. Scattered: Madison, Butler, and Jackson counties.

Malus bracteata Rehder in Sarg. Trees & Shrubs **2**: 230. 1913.

Open woods and thickets. Circumneutral. Southeastern Mo.: Dunklin Co.

× **Malus Soulardi** (Bailey) Britton.

× *Pyrus Soulardi* Bailey (G).

A hybrid between *Malus pumila* and *M. ioensis*. Occasionally found in the range of the latter.

Amelanchier canadensis (L.) Medic. See Rh. **14**: 150. 1912. Juneberry, Shad Bush, Service Berry.

Amelanchier canadensis var. *Botryapium* (L.f.) T. & G. (G).

Rocky woods and along bluffs. Oxylophile to circumneutral. General, but apparently absent from some of the northern counties.

Amelanchier humilis Wiegand, Rh. **14**: 126, 141. 1912.

Open ground and prairie banks along railroad. Western Mo.: Pettis and Lawrence counties. Probably introduced.

Crataegus crus-galli L. Cockspur Thorn.

Crataegus albanthera Sarg.

Crataegus calophylla Sarg.

Crataegus candens Sarg.

Crataegus efferta Sarg.

Crataegus effulgens Sarg.

Crataegus ferox Sarg.

Crataegus hamata Sarg.

Crataegus Parkae Sarg.

Crataegus polyclada Sarg.

Crataegus severa Sarg.

Crataegus strongylophylla Sarg.

Crataegus tardiflora Sarg.

Thickets, pastures, and borders of woods, rocky or alluvial ground. Circumneutral to calciphile. General and common.

Crataegus crus-galli f. **truncata** (Sarg.) Palmer, comb. nov.

Crataegus truncata Sarg.

Occasionally found with the typical form. Southern Mo.: Taney Co.

Crataegus crus-galli var. **exigua** (Sarg.) Eggleston.

Crataegus exigua Sarg.

Crataegus rudis Sarg.

Occasionally found with the typical form. Shannon Co.

Crataegus crus-galli var. **macra** (Beadle) Palmer, comb. nov.

Crataegus macra Beadle.

Crataegus consueta Sarg.

Crataegus monosperma Sarg.

Crataegus permera Sarg.

Found in similar situations to the typical form. Calciphile to circumneutral.

Central and southern Mo.: Boone, Butler, Shannon, Ozark, Taney, and Greene counties.

Crataegus crus-galli var. **barrettiana** (Sarg.) Palmer, comb. nov.

Crataegus barrettiana Sarg.

Found in similar situations to the typical form. Eastern Mo.: St. Louis Co.

Crataegus crus-galli var. **leptophylla** (Sarg.) Palmer, comb. nov.

Crataegus leptophylla Sarg.

Found in similar situations to the typical form. Scattered: Osage, Madison, and Wayne counties.

Crataegus crus-galli var. **pachyphylla** (Sarg.) Palmer, comb. nov.

Crataegus pachyphylla Sarg.

Thickets and open woods along streams. Calciphile to circumneutral. Scattered: Osage and St. Francois counties.

Crataegus crus-galli var. **bellica** (Sarg.) Palmer, comb. nov.

Crataegus bellica Sarg.

Thickets and borders of woods; gravelly hills and alluvial ground. Circumneutral to calciphile. Southeastern Mo.: Butler Co.

Crataegus tantula Sarg.

Crataegus lawrencensis Sarg.

Thickets along streams. Circumneutral to calciphile. Southwestern Mo.: Lawrence, Jasper, and Newton counties.

Crataegus rotunda Sarg.

Prairies and thickets along small streams. Circumneutral to calciphile. Southwestern Mo.: Jasper, Newton, and Barry counties.

Crataegus discolor Sarg.

Crataegus jasperensis Sarg.

Crataegus parciflora Sarg.

Crataegus rubrisepala Sarg.

Crataegus rubrifolia Sarg.

Crataegus tenuisepala Sarg.

Thickets, pastures, and borders of woods, along small streams. Calciphile to circumneutral. Southern Mo.: Butler, Carter, Texas, Douglas, Dallas, Barry, and Jasper counties.

Crataegus acutifolia Sarg.

Crataegus erecta Sarg.

Crataegus ludoviciensis Sarg.

Open woods and borders of woods along streams. Circumneutral to calciphile. Northern and east-central Mo.: Clark, Daviess, Pike, St. Louis, and Osage counties.

Crataegus Palmeri Sarg.

Thickets, pastures, and open woods; on limestone hills or along small streams. Calciphile to circumneutral. Southwestern Mo.: Vernon, Lawrence, Jasper, Newton, and McDonald counties.

Crataegus intermixta Sarg.

Thickets, pastures, and limestone hills. Calciphile to circumneutral. Eastern Mo., north of the Missouri River: Marion, Ralls, and Pike counties.

Crataegus regalis Beadle.

Rocky open woods and thickets. Circumneutral to calciphile. Southern Mo.: Oregon Co.

Crataegus regalis var. **paradoxa** (Sarg.) Palmer, comb. nov.

Crataegus paradoxa Sarg.

Prairies and thickets along small streams. Circumneutral to calciphile. Southwestern Mo.: Jasper and Newton counties.

Crataegus pyracanthoides Beadle var. **arborea** (Beadle) Palmer, comb. nov.

Crataegus arborea Beadle.

Crataegus tenuispina Sarg.

Open woods and banks of small streams. Circumneutral to calciphile. Southeastern Mo.: Dunklin, Wayne, Carter, and Shannon counties.

Crataegus hannibalensis Palmer, Jour. Arnold Arb. **16**: 353. 1935.

Thickets, borders of woods, and along bluffs. Calciphile to circumneutral. Northern and eastern Mo.: Schuyler, Clark, Marion, Ralls, Pike, Monroe, St. Francois, Mercer, Harrison, and Clinton counties.

Crataegus Danielsi Palmer, Jour. Arnold Arb. **16**: 355. 1935.

Thickets, limestone hills, and bluffs. Calciphile to circumneutral. Central Mo.: Boone Co.

Crataegus Danielsi f. **glabra** Palmer, Jour. Arnold Arb. **16**: 357. 1935.

Rarely found with the typical form. Central Mo.: Boone Co.

Crataegus vallicola Sarg.

Crataegus phaneroneura Sarg.

Thickets and borders of woods, limestone hills, and along bluffs. Calciphile to circumneutral. Eastern and middle Mo.: Macon, Pike, Lincoln, St. Louis, and Dent counties.

Crataegus Engelmannii Sarg.

Crataegus barbata Sarg.

Crataegus hirtella Sarg.

Crataegus munita Sarg.

Crataegus pilifera Sarg.

Crataegus setosa Sarg.

Crataegus villiflora Sarg.

Thickets and open woods, glades, and limestone hills. Calciphile to circumneutral. Central and southern Mo.: St. Louis, Franklin, St. Francois, Ste. Genevieve, Iron, Wayne, Butler, Dunklin, Carter, Texas, Dent, Phelps, Pulaski, Cole, Dallas, Polk, Webster, Christian, Taney, Stone, Barry, Jasper, Newton, and McDonald counties.

Crataegus Engelmannii f. **nuda** Palmer, f. nov.

Crataegus infesta Sarg.

Crataegus tenuis Sarg.

Occasionally found with the typical form. Scattered: St. Louis, Franklin, and Jasper counties.

A typo differt foliis inflorescentiis ramulisque novellis glabris.

Crataegus fecunda Sarg.

Thickets and open ground along streams. Calciphile to circumneutral. Cen-

tral and southeastern Mo.: Boone, St. Louis, Ste. Genevieve, Cape Girardeau, and Wayne counties.

Crataegus collina Chapm.

Crataegus angustata Sarg.

Crataegus macropoda Sarg.

Crataegus sucida Sarg.

Crataegus sordida var. *villosa* Sarg.

Crataegus vicina Sarg.

Thickets and open woods; on limestone hills or along small streams. Calciphile to circumneutral. Central and southern Mo.: Boone, St. Louis, Franklin, Washington, St. Francois, Ste. Genevieve, Cape Girardeau, Iron, Wayne, Butler, Ripley, Carter, Oregon, Shannon, Texas, Phelps, Maries, Osage, Benton, Morgan, Greene, Taney, Stone, Barry, Jasper, Newton, and McDonald counties.

Crataegus collina var. **succincta** (Sarg.) Palmer, comb. nov.

Crataegus succincta Sarg.

Thickets, limestone hills, and glades. Calciphile to circumneutral. Eastern Mo., south of the Missouri River: St. Louis, Franklin, St. Francois, and Wayne counties.

Crataegus collina var. **secta** (Sarg.) Palmer, comb. nov.

Crataegus secta Sarg.

Thickets, limestone hills, and along small streams. Central and southern Mo., scattered: Miller, Greene, and Jasper counties.

Crataegus collina var. **sordida** (Sarg.) Palmer, comb. nov.

Crataegus sordida Sarg.

Thickets, limestone hills. Calciphile to circumneutral. Southern Mo.: Ripley, Carter, Shannon, and Greene counties.

Crataegus verruculosa Sarg.

Thickets and borders of woods. Calciphile to circumneutral. Central and southern Mo., scattered: Boone, Cape Girardeau, Bollinger, Shannon, and Greene counties.

Crataegus hirtiflora Sarg.

Thickets and borders of woods. Calciphile to circumneutral. Southern Mo., local: Taney and Stone counties.

Crataegus latebrosa Sarg.

Thickets and open woods along rocky streams. Calciphile to circumneutral. Southwestern Mo., local: McDonald county.

Crataegus Lettermanii Sarg.

Open woods and thickets along streams. Circumneutral to calciphile. Central and southern Mo., scattered: St. Louis, Ste. Genevieve, and Jasper counties. Probably a hybrid between *Crataegus collina* and *C. mollis.*

Crataegus viridis L. Green Haw.

Crataegus arborescens Ell.

Crataegus Davisii Sarg.

Crataegus furcata Sarg.

Crataegus larga Sarg.

Crataegus Pechiana Sarg.

Low wet woods, and limestone hills and bluffs with seepage water. Calciphile to circumneutral. Eastern, central, and southern Mo.: Marion, Ralls, Pike, St. Louis, Gasconade, Osage, Cole, Mississippi, Pemiscot, Dunklin, Stoddard, Butler, Ripley, Howell, Jasper, and Newton counties.

Crataegus viridis var. **ovata** (Sarg.) Palmer, comb. nov.

Crataegus ovata Sarg.

Crataegus nitens Sarg.

Occasionally found with the typical form. Marion, Ralls, St. Louis, Stoddard, and Jasper counties.

Crataegus viridis var. **lanceolata** (Sarg.) Palmer, comb. nov.

Crataegus lanceolata Sarg.

Occasionally found with the typical form. Marion, Ralls, St. Louis, Dunklin, and Jasper counties.

Crataegus viridis var. **lutensis** (Sarg.) Palmer, comb. nov.

Crataegus lutensis Sarg.

Low woods and rocky glades. Circumneutral. Southwestern Mo.: Bates, Vernon, St. Clair, Jasper, and Newton counties.

Crataegus viridis var. **atrorubens** (Ashe) Palmer, comb. nov.

Crataegus atrorubens Ashe.

Crataegus Dawsoniana Sarg.

Low wet or alluvial woods. East-central Mo.: St. Louis Co.

Crataegus nitida (Engelm.) Sarg.

Thickets and borders of woods, limestone hills and bluffs along the Mississippi River. Calciphile. Northeastern Mo.: Marion and Ralls counties.

Crataegus padifolia Sarg.

Glades and rocky hillsides. Circumneutral to calciphile. Southwestern Mo.: Ozark, Taney, and Stone counties.

Crataegus padifolia var. **incarnata** Sarg.

Rocky open woods. Circumneutral to calciphile. Southwestern Mo.: Stone Co.

Crataegus neobushii Sarg.

Crataegus leioclada Sarg.

Glades, thickets, and rocky open woods. Circumneutral to calciphile. Southern Mo.: Iron, Ripley, Shannon, Dallas, Taney, and Stone counties.

Crataegus biltmoreana Beadle.

Crataegus villicarpa Sarg.

Glades and rocky hillsides. Circumneutral to calciphile. Southern Mo.: Shannon, Taney, Stone, and Barry counties.

Crataegus Margaretta Ashe.

Thickets, borders of woods, and rocky open ground. Circumneutral to calciphile. Eastern and southern Mo.: Putnam, Schuyler, Adair, Scotland, Clark, Lewis, Knox, Shelby, Marion, Ralls, Pike, Lincoln, St. Louis, St. Francois, Madison, Dallas, Polk, Cedar, Greene, and Christian counties.

Crataegus sicca Sarg.

Crataegus glabrifolia Sarg.

Thickets and rocky open woods. Circumneutral to calciphile. Eastern and

middle Mo., south of the Missouri River: Franklin, Washington, Bollinger, Wayne, Carter, Cole, and Laclede counties.

Crataegus pruinosa (Wendl.) K. Koch.

Crataegus conjuncta Sarg.

Crataegus depressa Ashe, not Presl, in part.

Crataegus patrum Sarg.

Open woods and thickets, limestone hills and along small streams. Circumneutral. General, but commonest in northern and eastern Mo.

Crataegus pruinosa f. **angulata** (Sarg.) Palmer, comb. nov.

Crataegus arcana of Sarg., in part, not Beadle.

Crataegus angulata Sarg.

Occasionally found with the typical form. Carter Co.

Crataegus pruinosa var. **brachypoda** (Sarg.) Palmer, comb. nov.

Crataegus brachypoda Sarg.

Thickets and open woods. Circumneutral to calciphile. Occasionally found with the typical form. Southeastern Mo.: Carter and Ripley counties.

Crataegus rugosa Ashe.

Crataegus onusta Ashe.

Thickets, pastures, and borders of woods. Circumneutral to calciphile. Northern Mo.: Shelby, Mercer, and Harrison counties.

Crataegus disjuncta Sarg.

Crataegus tumida Sarg.

Thickets and open woods. Circumneutral to calciphile. East-central and southern Mo.: Franklin, Stoddard, Dent, Shannon, and Jasper counties.

Crataegus disjuncta var. **magnifolia** (Sarg.) Palmer, comb. nov.

Crataegus magnifolia Sarg.

Thickets and open woods, limestone hills and along small streams. Circumneutral to calciphile. Southwestern Mo.: Cedar, Dade, Lawrence, Barton, and Jasper counties.

Crataegus Mackenzii Sarg.

Crataegus depressa Ashe, not Presl, in part.

Crataegus rubicundula Sarg.

Thickets, pastures and glades. Circumneutral to calciphile. General: Schuyler, Adair, St. Louis, Franklin, Washington, Iron, Cape Girardeau, Bollinger, Butler, Miller, Jackson, Benton, Greene, and Stone counties.

Crataegus Mackenzii var. **bracteata** (Sarg.) Palmer, comb. nov.

Crataegus bracteata Sarg.

Crataegus aperta Sarg.

Crataegus calliantha Sarg.

Crataegus rigida Sarg.

Crataegus seclusa Sarg.

Crataegus seducta Sarg.

Rocky open woods, thickets, and pastures. Circumneutral to calciphile. Central and southern Mo.: Boone, Franklin, St. Francois, Madison, Bollinger, Carter, Ripley, Phelps, Pulaski, Miller, Camden, Laclede, Dallas, Ozark, Taney, Stone, Barry, Johnson, Jasper, Newton, and McDonald counties.

Crataegus Gattingeri Ashe.

Rocky open woods and thickets. Circumneutral. Southeastern Mo.: Madison, Iron, and Wayne counties.

Crataegus platycarpa Sarg.

Open woods and thickets. Circumneutral to calciphile. Eastern Mo.: Schuyler, Lincoln, Iron, and Wayne counties.

Crataegus aspera Sarg.

Rocky open woods, thickets, and pastures. Circumneutral to calciphile. Southern Mo.: Ripley, Taney, Stone, Barry, and Jasper counties.

Crataegus locuples Sarg.

Open woods and thickets. Circumneutral to calciphile. East-central and Southeastern Mo.: St. Louis, Wayne, and Carter counties. Probably a hybrid between *Crataegus mollis* and *C. pruinosa* or a related species.

Crataegus mollis (T. & G.) Scheele. Summer Haw, Turkey Apple.

Crataegus macrophylla Sarg.
Crataegus lanigera Sarg.
Crataegus lasiantha Sarg.
Crataegus umbrosa Sarg.
Crataegus valens Ashe.
Crataegus verna Ashe.

Open woods and thickets along streams. Circumneutral to calciphile. General, but commonest in northern and central Mo., and apparently absent from some of the Ozark counties.

Crataegus mollis f. dumetosa (Sarg.) Palmer, comb. nov.

Crataegus dumetosa Sarg.

Occasionally found with the typical form. Jasper and Taney counties.

Crataegus noelensis Sarg.

Crataegus transmississippiensis Sarg.

Rocky open woods and thickets along streams. Circumneutral to calciphile. Western Mo., south of the Missouri River: Webster, Benton, Dallas, Greene, Barry, Stone, and McDonald counties.

Crataegus dispessa Ashe.

Crataegus pyriformis Britton.
Crataegus Treleasei Sarg.

Rocky open woods along streams. Circumneutral to calciphile. Southern Mo.: St. Francois, Shannon, Howell, and Dallas counties.

Crataegus lanuginosa Sarg.

Crataegus dasyphylla Sarg.

Open woods, thickets, and pastures; limestone hills and along small streams. Circumneutral to calciphile. Southwestern Mo.: Jasper, Newton, and Barry counties.

Crataegus Kelloggi Sarg.

Thickets along small streams. Circumneutral to calciphile. Scattered: Putnam, Lincoln, St. Louis, and Greene counties. Probably a hybrid between *Crataegus Margaretta* and *C. mollis*.

Crataegus declivitatis Sarg.

Rocky open woods and bluffs. Circumneutral to calciphile. East-central Mo., local: St. Louis and St. Francois counties. Probably a hybrid between *Crataegus mollis* and *C. pruinosa.*

Crataegus coccinioides Ashe.

Crataegus callicarpa Sarg.

Crataegus speciosa Sarg.

Thickets and open woods; limestone hills. Circumneutral to calciphile. Southern Mo.: St. Louis, Franklin, St. Clair, Cedar, Dade, Jasper, Newton, and Barry counties.

Crataegus spathulata Michx.

Crataegus apiifolia var. *flavanthera* Sarg.

Crataegus spathulata var. *flavanthera* Sarg. ex Palmer.

Open woods and thickets. Circumneutral. Southwestern Mo.: Taney and Jasper counties.

Crataegus Marshallii Eggleston. Parsley Haw.

Crataegus apiifolia (Marsh.) Michx., not Medic.

Low swampy woods. Circumneutral. Southeastern Mo.: Dunklin and Butler counties.

Crataegus Phaenopyrum (L.f.) Medic. Washington Thorn.

Crataegus cordata Ait.

Thickets and borders of woods. Circumneutral to calciphile. Central and southern Mo.: Boone, Maries, Washington, Crawford, St. Francois, Wayne, Carter, Ripley, Shannon, Texas, Howell, Greene, Stone, and Jasper counties.

Crataegus uniflora Muench.

Crataegus trianthophora Sarg.

Crataegus tomentosa Eggleston, not L. (G).

Rocky open woods and glades. Circumneutral to oxylophile. Southern Mo.: Ripley, Shannon, Wayne, Carter, Texas, Douglas, and Ozark counties.

Crataegus calpodendron (Ehrh.) Medic.

Crataegus tomentosa of auth., not L. (?).

Crataegus insperata Sarg.

Crataegus obscura Sarg.

Thickets, open woods, and rocky ground along streams and bluffs. Circumneutral to calciphile. General.

Crataegus calpodendron var. **obesa** (Ashe) Palmer, comb. nov.

Crataegus obesa Ashe.

Crataegus globosa Sarg. (B & B).

Crataegus mollicula Sarg.

Rocky woods, thickets, and banks of streams. Circumneutral to calciphile. Central and southern Mo.: St. Louis, Iron, Madison, Wayne, Carter, Ripley, Shannon, Oregon, Jackson, Benton, Hickory, Polk, Greene, Christian, Ozark, Taney, Stone, Barry, Jasper, and McDonald counties.

Crataegus calpodendron var. **hispidula** (Sarg.) Palmer, comb. nov.

Crataegus hispidula Sarg.

Crataegus spinulosa Sarg.

Thickets, open woods, and banks or bluffs of streams. Circumneutral to calciphile. Southern Mo., scattered: St. Francois, Polk, Stone, and Jasper counties.

Crataegus succulenta Schrad.

Crataegus neofluvialis Ashe (B & B).

Crataegus macracantha var. *neofluvialis* (Ashe) Eggleston (G), in part.

Crataegus ensifera Sarg.

Thickets and borders of woods, along streams. Circumneutral to calciphile. Scattered: Harrison, Montgomery, Benton, and Christian counties.

Crataegus succulenta var. **pertomentosa** (Ashe) Palmer, comb. nov.

Crataegus pertomentosa Ashe (G), B & B).

Crataegus campestris Britton.

Rocky open woods, glades, and rocky ground along streams. Calciphile to circumneutral. Scattered, mostly in northern and central Mo.: Mercer, Macon, Clark, Marion, Ralls, Wayne, and Jackson counties.

Crataegus nuda Sarg.

Glades and rocky ground along streams. Circumneutral to calciphile. Southwestern Mo., local: Taney Co. Perhaps a hybrid between *Crataegus crus-galli* and *C. succulenta.*

Crataegus simulata Sarg.

Open woods and thickets along streams. Circumneutral to calciphile. Southwestern Mo., local: Jasper Co. Probably a hybrid between *Crataegus calpodendron* var. *obesa* and *C. Palmeri.*

Crataegus incaedua Sarg.

Crataegus pudens Sarg.

Crataegus swanensis Sarg.

Rocky open woods, glades, and banks of streams. Circumneutral to calciphile. Southern Mo., scattered: Shannon, Carter, Dallas, and Taney counties.

Crataegus Vailiae Britton.

Crataegus missouriensis Ashe.

Bluffs and rocky banks of streams. Circumneutral. Southeastern Mo.: Shannon and Ripley counties.

Crataegus collina × viridis

Thickets, low hills bordering lowlands. Local: Cape Girardeau Co.

Crataegus Engelmannii × uniflora.

Rocky glades. Local: Ozark Co.

Waldsteinia fragarioides (Michx.) Trattinick.

Shaded cherty or sandstone upland slopes. Oxylophile. Southern Mo.: Texas and Douglas counties.

Fragaria virginiana Duchesne. Wild Strawberry.

Prairies and open cleared lands. Circumneutral. General but scattered.

Fragaria virginiana var. **illinoensis** (Prince) Gray.

Fragaria Grayana Vilmorin (S).

Similar situations to the preceding. General and more common.

Fragaria vesca L. var. **americana** Porter.

Prairies and borders of woods and thickets. Circumneutral. Scattered: Jasper Co.

FRAGARIA CHILOENSIS Duchesne var. ANANASSA (Duchesne) Hort. ex Bailey. Garden Strawberry.

Fragaria grandiflora Ehrh.

Cultivated and occasionally escaped. Scattered: Andrew Co.

DUCHESNEA INDICA (Andr.) Focke. Indian Strawberry.

Prairies, open woods, and waste ground. Circumneutral. Scattered and uncommon: Dunklin and Jackson counties.

Potentilla arguta Pursh.

Rocky woods and prairies. Oxylophile to circumneutral. General but scattered: Schuyler, Linn, Lewis, St. Louis, Carter, Worth, Clinton, Jackson, Greene, and Barry counties.

Potentilla norvegica L. var. **hirsuta** (Michx.) Lehm. See Rh. **28**: 213–214. 1926.

Potentilla monspeliensis L. (G), (B & B).

Prairies, meadows, and waste ground. Circumneutral. General.

Potentilla rivalis Nutt.

Prairies and open banks. Circumneutral. St. Louis, Jefferson, and Jackson counties.

Potentilla rivalis var. **millegrana** (Engelm.) Wats.

Prairies, meadows, and waste ground. Circumneutral. Central Mo., and perhaps more general: St. Louis, Jefferson, Boone, and Jackson counties.

Potentilla rivalis var. **pentandra** (Engelm.) Wats.

Prairies and waste ground. Circumneutral. Local: Jackson Co.

Potentilla paradoxa Nutt.

Rocky open woods, upland prairies, and banks of streams. Circumneutral. Central and southern Mo.: St. Louis, Perry, Boone, Saline, Carroll, Clay, Jackson, and Holt counties.

Potentilla Nicolletii (Wats.) Sheldon.

Sandy bottoms along Missouri and Mississippi Rivers. Oxylophile. Scattered: Perry, Carroll, and Jackson counties.

POTENTILLA RECTA L.

Fields, meadows, and waste ground. Indifferent. Introduced and becoming more common. General but scattered: St. Louis, Jefferson, Franklin, Washington, St. Francois, Madison, Iron, Crawford, Phelps, Boone, Saline, Jackson, and Jasper counties.

Potentilla canadensis L. var. **villosissima** Fernald, Rh. **33**: 187. 1931.

Potentilla caroliniana of Rydb., not Poir. (G), (B & B).

Dry open woods, prairies, and open banks. Oxylophile. Southern Mo., eastern Ozark region: Dent, Reynolds, Shannon, Texas, and Howell counties.

Potentilla simplex Michx. See Rh. **33**: 188. 1931. Cinquefoil.

Potentilla canadensis of auth., not L. (G), (B & B).

Rocky open woods, prairies, and waste ground. Oxylophile to circumneutral. General and common.

Potentilla simplex var. **calvescens** Fernald, Rh. **33**: 189. 1931.

Potentilla canadensis var. *simplex* of auth., not (Michx.) T. & G. (G).

Potentilla simplex of auth., not Michx. (B & B).

Rocky open woods and prairies. Circumneutral: St. Louis, Boone, Jackson, Douglas, Greene, and Jasper counties.

Potentilla simplex var. **argyrisma** Fernald, Rh. **33**: 191. 1931.

Prairies and dry open ground. Circumneutral. Scattered in southwestern Mo.: Barton and Pettis counties.

Geum canadense Jacq.

Rich woods. Circumneutral. Scattered: Lewis, Monroe, Dallas, Hickory, and Miller counties.

Geum canadense var. **camporum** (Rydb.) Fernald & Weatherby, Rh. **24**: 49. 1922. Red Root.

Geum canadense of auth. in part (G), (B & B).

Woods and meadows. Circumneutral. General and common.

Geum laciniatum Murr. var. **trichocarpum** Fernald, Rh. **37**: 293. 1935. Rough Avens.

Geum virginianum of auth. in part, not L. (G).

Moist woods. Circumneutral. Northern and central Mo.: Scotland, Adair, Marion, Ralls, Monroe, Audrain, and Jackson counties.

Geum vernum (Raf.) T. & G. Early Water Avens.

Moist woods, thickets, and open boggy ground. Circumneutral. General.

Rubus idaeus L. var. **strigosus** (Michx.) Maxim. Red Raspberry.

Rubus idaeus var. *aculeatissimus* (C. A. Mey.) Regel & Tiling (G).

Loess hills in northwestern Mo., and also in Jackson Co., where it is probably introduced: Atchison, Holt, and Jackson counties.

Rubus occidentalis L. Black Raspberry.

Thickets and open woods. Circumneutral. General and probably in every county.

RUBUS PROCERUS P. J. Muell.

Cultivated and occasionally escaped. Waste ground. Scattered: Jasper Co.

Rubus allegheniensis Porter. High-bush Blackberry.

Rocky open woods, thickets, and bluffs. Circumneutral. General but scattered.

Rubus alumnus Bailey, Gent. Herb. **1**: 191, *fig. 88.* 1923.

Thickets, and banks and bluffs of streams. Circumneutral to oxylophile. Eastern, central, and southern Mo.: Marion, St. Francois, Iron, Madison, Bollinger, Cape Girardeau, Scott, Mississippi, Butler, Wayne, Carter, Shannon, Phelps, Morgan, Jackson, Stone, Jasper, and Newton counties.

Rubus laudatus Berger.

Rocky thickets and borders of woods. Circumneutral. Central and southern Mo., scattered: Boone, Wayne, Saline, Jackson, Barry, and McDonald counties.

Rubus Deamii Bailey, Gent. Herb. **2**: 463, *fig. 203.* 1932.

Thickets and old fields. Circumneutral. Southern Mo.: Texas Co.

Rubus ostryifolius Rydb. High-bush Blackberry.

Rubus Andrewsianus Blanchard (G).

Rubus argutus of auth., not Link. (B & B).

Woods, thickets, fields, and fence rows. Circumneutral. General, and probably in every county.

Rubus Bushii Bailey, Gent. Herb. **2**: 403. 1932.

High rocky prairies, thickets, and open ground. Circumneutral to oxylophile. Southwestern Mo.: Barton and Jasper counties.

Rubus frondosus Bigel.

Thickets and woods along streams. Circumneutral. General but not common: Clark, Marion, Macon, Iron, Phelps, Boone, Cooper, Morgan, Jasper, and Newton counties.

Rubus abactus Bailey, Gent. Herb. **2**: 452, *figs. 196, 197, 198.* 1932.

Thickets, pastures, and waste ground. Circumneutral. Scattered: Boone, Phelps, and Clay counties.

Rubus heterophyllus Willd.

Rubus recurvans Blanchard (G).

Dry open ground and borders of woods. Circumneutral. Northwestern Mo.: Nodaway and Jackson counties.

RUBUS LACINIATUS Willd.

Cultivated ground. Introduced in Barry Co.

Rubus missouricus Bailey, Gent. Herb. **2**:459, *fig. 200.* 1932.

Prairies and thickets. Circumneutral. Western Mo.: Jackson Co.

Rubus trivialis Michx.

Rubus rubrisetus Rydb. (G), (B & B), in part.

Rubus continentalis Bailey.

Moist thickets and open ground. Circumneutral. Central and southern Mo.: St. Louis, Jefferson, Perry, Cape Girardeau, Bollinger, Madison, Iron, Mississippi, Pemiscot, Butler, Ripley, Carter, Shannon, Phelps, Jackson, Jasper, and McDonald counties.

Rubus nefrens Bailey, Gent. Herb. **1**: 239, *fig. 111.* 1925.

Prairies, old fields, and open banks. Circumneutral. Central and southern Mo., scattered: Bollinger, Iron, Texas, Jackson, and Jasper counties.

Rubus flagellaris Willd. See Gent. Herb. **2**: 317. 1932. Dewberry.

Rubus villosus Ait. (G).

Rubus procumbens Muhl. (B & B).

Open rocky woods, thickets, prairies, and railway embankments. Circumneutral. General and probably in every county.

Rubus flagellaris var. **occidualis** Bailey, Gent. Herb. **2**: 318. 1932.

Thickets and banks along prairie streams. Circumneutral. General but scattered: Clark, Marion, Audrain, Texas, Saline, Jackson, Vernon, and Jasper counties.

Rubus invisus Bailey.

Thickets, prairies, and rocky banks. Circumneutral. Jackson and Morgan counties.

Agrimonia pubescens Wallr. See N. Am. Fl. **22**: 393. 1913.

Agrimonia mollis (T. & G.) Britton (G), (B & B).

Rocky open woods and thickets. Circumneutral. General.

Agrimonia microcarpa Wallr.

Low ground along streams. Circumneutral. Eastern Mo., south of the Missouri River, scattered: St. Louis and St. Francois counties.

Agrimonia gryposepala Wallr.

Rocky open woods. Circumneutral. Scattered: Clark, Putnam, Macon, and Douglas counties.

Agrimonia parviflora Ait.

Low open woods, moist thickets, and boggy ground along prairie streams. Circumneutral to oxylophile. General.

Agrimonia rostellata Wallr.

Open woods, rocky slopes, and thickets. Circumneutral. Southern and central Mo., south of a line from St. Louis, Warren, and Boone counties to Jackson Co.

Agrimonia platycarpa Wallr.

Low or rocky woods. Circumneutral. General, but scattered: Marion, Ralls, St. Louis, St. Francois, Shannon, Texas, Greene, Taney, Clay, Jackson, Jasper, and Newton counties.

Rosa setigera Michx. Prairie Rose, Climbing Rose.

Low open woods and moist rocky ground along streams. Circumneutral. Central and southern Mo., scattered: Bollinger, Scott, Dunklin, Butler, Shannon, Pulaski, Saline, Pettis, and Jasper counties.

Rosa setigera f. **inermis** Palmer & Steyermark, f. nov.

Open woods and rocky ground along streams. Occasionally found with the typical form. Circumneutral. Southeastern Mo., scattered: Bollinger and Shannon counties.

A typo recedit ramulis inermibus vel raro paucis tenuibus spinis.

The unarmed glabrous form appears to be comparatively rare and we have seen specimens only from southeastern Missouri. It differs from the type only in the canes and branches being entirely unarmed or rarely with a few small scattered spines.

MISSOURI: Patton, Bollinger Co., April 26, 1931, *E. J. Palmer 39093* (Arn. Arb. TYPE); Monteer, Shannon Co., July 30, 1930, *B. F. Bush 11907* (Arn. Arb.).

Rosa setigera var. **tomentosa** T. & G.

Rocky open woods, thickets, and prairies. Circumneutral. General and probably in every county.

Rosa setigera var. **serena** Palmer and Steyermark, var. nov.

Open woods, and rocky banks or bluffs of streams. Circumneutral. Southern Mo.: Iron, Reynolds, Carter, Ripley, Shannon, Ozark, Taney, Christian, Stone, and Barry counties.

A typo recedit foliis subter pubescentibus; ramulis inermibus vel raro paucis spinis.

This variety is distinguished from var. *tomentosa* T. & G., which it resembles, in the pubescent under surface of the leaves, and by its smooth spineless canes and branches, although rarely a few small scattered thorns may be found on plants in which nearly all of the branches are entirely unarmed. It appears to be more distinct and constant in its distinguishing characters, as well as more isolated geographically, than the variety based solely on the more or less pubescent character of the leaves. In parts of the Ozark region, in southern Missouri and northern Arkansas, it is the prevailing form of *Rosa setigera*.

MISSOURI: Campbell, Dunklin Co., Oct. 7, 1910, *B. F. Bush 6385* (Arn. Arb.); Ponder, Ripley Co., July 2, 1933, *Palmer & Steyermark 41642* (Arn. Arb. TYPE, Mo. Bot. Gard. ISOTYPE); Monteer, Shannon Co., Oct. 6, 1920, *E. J. Palmer 19346* (Arn. Arb.); Chadwick, Christian Co., Oct. 5–10, 1915, *W. W. Eggleston 12297* (Arn. Arb.); Galena, Stone Co., Sept. 25, 1923, *E. J. Palmer 23844*, and Sept. 15, 1934, *26135* (Arn. Arb.); Roark, Stone Co., Sept. 28, 1920, *E. J. Palmer 19213* (Arn. Arb.); Melva, Stone Co., Sept. 17, 1924, *E. J. Palmer 26194* (Arn. Arb.); Branson, Taney Co., June 8, 1914, *E. J. Palmer 5897* (Arn. Arb.); Swan, Taney Co., June 9, 1899, *B. F. Bush 47* (Arn. Arb.); Tecumseh, Ozark Co., Oct, 7. 1927, *E. J. Palmer 32902* (Arn. Arb.); Gainesville, Ozark Co., June 26, 1928, *E. J. Palmer 34724* (Arn. Arb.); Isabella, Ozark Co., June 27, 1928, *E. J. Palmer 3477* (Arn. Arb.); Eagle Rock, Barry Co., July 27, 1926, *E. J. Palmer 31439* (Arn. Arb.).

ARKANSAS: Cotter, Baxter Co., Sept. 19, 1924, *E. J. Palmer 26216* (Arn. Arb.); opposite Cotter, Marion Co., June 14, 1914, *E. J. Palmer 5978* (Arn. Arb.); Eureka Springs, Carroll Co., Sept. 17, 1921, *E. J. Palmer 20486* (Arn. Arb.); Beaver, Carroll Co., April 30, 1926, *E. J. Palmer 29843* (Arn. Arb.).

Rosa rudiuscula Greene, Leaflets Bot. Obs. & Crit. **2**: 134. 1911.

Prairies and thickets. Circumneutral. Northern and western Mo.: Shelby, Pettis, Benton, Gentry, Nodaway, Jackson, Cass, Bates, Vernon, and Jasper counties.

Rosa suffulta Greene. See N. Am. Fl. **22**: 504. 1913; also Bull. Torr. Bot. Club **50**: 65. 1923.

Rosa heliophila Greene.

Rosa pratincola Greene, not R. Br. (G).

Prairies and thickets. Circumneutral to calciphile. Northern, central, and western Mo., mostly in the prairie region: Scotland, Knox, Boone, Saline, Pettis, Worth, Nodaway, Atchison, Clinton, Platte, Ray, Jackson, Cass, Bates, and Vernon counties.

Rosa suffulta var. **valida** Erlanson, Rh. **30**: 114. 1928.

Occasionally found with the typical form. Northwestern Mo.: Atchison Co.

Rosa blanda Ait. Meadow Rose.

Thickets and open woods. Circumneutral. Northeastern Mo.: Clark and Schuyler counties.

Rosa relicta Erlanson, Rh. **30**: 116. 1928.

Prairies and thickets. Circumneutral. Northern and central Mo.: Schuyler, Worth, Dekalb, Cooper, Morgan, Lafayette, Johnson, Henry, and St. Clair counties.

Rosa Aucuparia Rydb. N. Am. Fl. **22**: 501. 1918.

Thickets and open woods. Circumneutral. Northern and central Mo., scattered: Clark, Jackson, Cooper, and Morgan counties.

Rosa conjuncta Rydb. N. Am. Fl. **22**: 505. 1918.

Open banks, loess hills, and bluffs. Calciphile to circumneutral. Northwestern Mo.: Atchison, Nodaway, Dekalb, and Jackson counties.

Rosa Bushii Rydb. N. Am. Fl. **22**: 506. 1918.

Thickets and open banks. Circumneutral. Northern and central Mo.: Putnam, Jackson, and Lafayette counties.

Rosa Palmeri Rydb. N. Am. Fl. **22**: 502. 1918.

Prairies and thickets. Circumneutral. Middle and western Mo.: Clinton, Randolph, Jasper, and Stone counties.

Rosa subserrulata Rydb. N. Am. Fl. **22**: 500. 1918.

Rocky woods and glades. Circumneutral to oxylophile. Central and southern Mo., mostly in the Ozark region and locally north to St. Louis, Pike, and Jackson counties.

Rosa petiolata Rydb. N. Am. Fl. **22**: 501. 1918.

Thickets and prairies. Circumneutral. Northeastern Mo.: Clark Co.

Rosa polyanthema Lunell, Am. Midl. Nat. **3**: 138. 1913.

Thickets, open banks, loess hills, and prairies. Circumneutral to calciphile. Northwestern Mo.: Grundy, Caldwell, Nodaway, Atchison, Holt, and Buchanan counties.

Rosa carolina L. See Rh. **20**: 91. 1918. Pasture Rose.

Rosa humilis Marsh. (G).

Rosa virginiana of auth. in part, not L. (B & B).

Thickets, open woods, and prairies. Circumneutral. General and probably in every county.

Rosa carolina var. **grandiflora** (Baker) Rehder in Bailey, Stand. Cyclop. Hort. **5**: 2991. 1916.

Rosa obovata Raf.

Rocky open woods and thickets. Circumneutral. General but scattered: Clark, Lewis, Marion, Putnam, Adair, Grundy, Daviess, Shannon, Texas, Wright, Cedar, Hickory, Jasper, and Newton counties.

Rosa carolina var. **glandulosa** (Crepin) Farwell, Rept. Mich. Acad. Sci. **21**: 366. 1920.

Rosa serrulata Raf.

Open woods and thickets. Circumneutral. Scattered: Maries, Schuyler, Clinton, and Jasper counties.

Rosa carolina var. **Lyoni** (Pursh) Palmer & Steyermark, comb. nov.

Rosa Lyoni Pursh.

Open woods, thickets, and rocky prairies. Circumneutral. General.

Rosa palustris Marsh. See Rh. **20**: 91. 1918. Swamp Rose.

Rosa carolina of auth., not L. (G), (B & B)).

Low swampy woods. Circumneutral. Southeastern Mo., in the lowlands: Cape Girardeau, Bollinger, Madison, Iron, Scott, Mississippi, Stoddard, Dunklin, Butler, Wayne, and Ripley counties.

Rosa palustris var. **dasistema** (Raf.) Palmer & Steyermark, comb. nov.

Rosa dasistema Raf.

Swamps and low wet woods. Circumneutral. Southeastern Mo.: in the lowlands: Scott, Stoddard, Dunklin, Butler, Wayne, and Iron counties.

ROSA RUGOSA Thunb.

Cultivated and escaped into fields and along railroads. Southwestern Mo., local: Greene Co.

ROSA EGLANTARIA L. Sweet-brier.

Rosa rubiginosa L. (G), (B & B).

Formerly planted in gardens and escaped and established in pastures and waste ground. Scattered: Clark, Marion, Montgomery, St. Louis, St. Francois, Boone, Dekalb, Clinton, Jackson, Johnson, and Jasper counties.

ROSA CANINA L. Dog Rose.

Occasionally escaped from gardens to roadsides and waste ground. Dade Co.

ROSA SPINOSISSIMA L.

Occasionally escaped to roadsides and waste ground. Boone Co.

ROSA CENTIFOLIA L.

An old garden rose, occasionally found as an escape in pastures and along roadsides. Clark Co.

Prunus serotina Ehrh. Wild Cherry.

Upland woods and along streams. Circumneutral. General and probably in every county.

Prunus virginiana L. Choke Cherry.

Thickets and borders of woods. Circumneutral. Northern and central Mo., mostly north of the Missouri River: Clark, Marion, Shelby, Schuyler, Putnam, Adair, Mercer, Harrison, Caldwell, Worth, Gentry, Clinton, Nodaway, Atchison, Buchanan, Sullivan, Boone, Saline, and Benton counties.

Prunus angustifolia Marsh. Chickasaw Plum.

Thickets and pastures. Circumneutral. General but scattered. Perhaps introduced by the Indians in prehistoric times: Grundy, Bollinger, Madison, Butler, Shannon, Jackson, Cass, Johnson, Pettis, Ozark, Stone, and Jasper counties.

Prunus angustifolia var. **varians** Wight & Hedrick, Plums of N. Y. p. 87. 1911.

Thickets, roadsides, and along prairie streams. Circumneutral. Central and southern Mo.: Dunklin, Ripley, Oregon, Johnson, Benton, Jasper, and Newton counties.

Prunus Munsoniana Wight & Hedrick, Plums of N. Y. p. 88. 1911. Wild Goose Plum.

Thickets, prairies, borders of streams, and waste ground. Circumneutral. General but scattered: Adair, Knox, Shelby, Marion, Monroe, Audrain, Boone, St. Louis, Cape Girardeau, Madison, Iron, Dunklin, Butler, Ripley, Shannon, Putnam, Mercer, Harrison, Caldwell, Jackson, Bates, Vernon, St. Clair, Dade, Taney, Stone, Jasper, Newton, and McDonald counties.

Prunus hortulana Bailey.

Thickets, open woods, and along streams. Circumneutral. General but commonest in central and southern Mo.

Prunus hortulana var. **pubens** Sarg. Trees & Shrubs **2**: 248. 1913.

Thickets and open woods. Circumneutral. General but scattered: Marion, Pike, Boone, Howard, Shannon, Ozark, Jackson, and Jasper counties.

Prunus americana Marsh. Wild Plum.

Thickets, open woods, and pastures. Circumneutral. General.

Prunus lanata (Sudw.) Mack. & Bush.

Prunus arkansana Sarg.

Thickets and open woods. Circumneutral. General. *Prunus Palmeri* Sarg., found in southwestern Mo. and later referred to this species, may be distinct or possibly a hybrid between this and *P. hortulana*.

Prunus mexicana Wats. Big Tree Plum.

Rocky open woods. Circumneutral. Southern Mo.: Dunklin, Butler, Shannon, Ozark, Taney, and Stone counties.

PRUNUS SPINOSA L.

Introduced in thickets. Jasper Co.

PRUNUS MAHALEB L. Perfumed Cherry.

Thickets, pastures, and roadsides. Used as grafting stock by nurserymen and often escaped. Scattered: Marion, Gasconade, Jackson, and Jasper counties.

PRUNUS CERASUS L. Sour Cherry.

Thickets and roadsides. Cultivated and occasionally escaped. Scattered: Marion, Holt, Jackson, and Barry counties.

Fam. LEGUMINOSAE

Acacia angustissima (Mill.) Ktze. Prairie Acacia.

Glades and rocky open ground. Circumneutral to calciphile. Southwestern Mo., local: Barry Co.

Acacia angustissima var. **hirta** (Nutt.) Robinson.

Glades, rocky hillsides, and exposed ledges along bluffs. Circumneutral to calciphile. Southwestern Mo.: Jasper, Newton, McDonald, Barry, Stone, and Taney counties.

Desmanthus illinoensis (Michx.) MacM. False Sensitive Plant.

Rocky open ground, thickets, and prairies. Circumneutral to oxylophile. General but apparently absent from much of the Ozark region.

Desmanthus leptolobus T. & G.

Low open ground. Circumneutral. Southeastern Mo.: Cape Girardeau Co. Perhaps introduced.

Schrankia uncinata Willd. Sensitive Brier.

Rocky prairies, open banks, and glades. Circumneutral to calciphile. General but absent from many of the eastern and northern counties: Putnam, Marion, Shelby, Macon, Audrain, Boone, Cole, Gasconade, Jefferson, Washington, Crawford, Iron, Wayne, Carter, Ripley, Oregon, Shannon, Howell, Dent, Osage, Phelps, Pulaski, Maries, Moniteau, Morgan, Laclede, Dallas, Wright, Webster, Hickory, Ozark, Douglas, Greene, Taney, Stone, Jackson, Johnson, Vernon, Barton, Jasper, Newton, and McDonald counties.

Gymnocladus dioica (L.) Koch. Kentucky Coffee-tree.

Woods, chiefly along small streams: sometimes in alluvial bottoms. Circumneutral. General but nowhere very common.

Gleditsia triacanthos L. Honey Locust.

Woods, chiefly along small streams; sometimes in low alluvial ground. Circumneutral. General and probably in every county.

Gleditsia triacanthos var. **inermis** Pursh.

Occasionally found with the common form, mostly in eastern and southern Mo.: Harrison, Mercer, Shelby, Monroe, St. Louis, Jefferson, Franklin, Washington, Iron, Mississippi, and McDonald counties.

Gleditsia aquatica Marsh. Water Locust.

Low wet woods and swamps. Circumneutral. Southeastern Mo., in the lowlands and locally north along the Mississippi River: St. Charles, St. Louis, Jefferson, Cape Girardeau, Bollinger, Scott, Mississippi, New Madrid, Dunklin, Butler, and Ripley counties.

Hoffmanseggia Jamesii T. & G.

Dumps and waste ground. Found as a waif in Jasper Co.

Cassia Medsgeri Shafer.

Thickets, open woods, and along rocky branches. Circumneutral. General. This has often been confused with *Cassia marilandica,* an eastern species which it resembles.

Cassia Tora L.

Rocky open ground along streams, and sandy bottoms. Oxylophile. Southeastern Mo.: Dunklin Co., and also introduced in Jackson Co.

CASSIA OCCIDENTALIS L. Coffee Weed.

Low alluvial ground. Circumneutral. Scattered: Introduced in Jackson and New Madrid counties.

Cassia fasciculata Michx. Partridge Pea.

Cassia Chamaecrista of auth., not L. (G).

Chamaecrista fasciculata (Michx.) Greene (B & B).

Thickets, glades, and rocky prairies. Circumneutral to oxylophile. General.

Cassia fasciculata f. **Jenseni** Palmer & Steyermark, f. nov.

Rarely occurring with the typical form. Local: Franklin Co.

A typo recedit petalis albis.

MISSOURI: Gray Summit, Franklin Co., Aug. 20, 1928, *L. P. Jensen* (Mo. Bot. Gard. TYPE). See Jensen, Mo. Bot. Gard. Bull. **19**: 38–39. 1931.

Differs from the typical form in having white instead of yellow petals.

Cassia fasciculata var. **robusta** (Pollard) Macbride, Contr. Gray Herb. N. S. 59: 24. 1919.

Cassia Chamaecrista var. *robusta* Pollard (G).

Chamaecrista fasciculata (Michx.) Greene, in part (B & B).

Occasionally found with the typical form. Circumneutral. Scattered: Lincoln, St. Charles, St. Louis, Perry, Pemiscot, Boone, and Polk counties.

Cassia fasciculata var. **depressa** (Pollard) Macbride.

Cassia depressa Pollard (G).

Chamaecrista depressa (Pollard) Greene (B & B).

Rocky open and alluvial ground. Circumneutral. Eastern Mo.: Washington Co.

Cassia nictitans L. Sensitive Pea.
Rocky woods, thickets, and prairies. Oxylophile to circumneutral. Central and southern Mo. south and east of a line from Lincoln, Montgomery, Boone, and St. Clair counties to Vernon Co.

Cercis canadensis L. Redbud.
Thickets and borders of woods, along rocky streams and bluffs. Circumneutral. General and probably in every county.

Baptisia leucantha T. & G. White Wild Indigo.
Prairies, glades, and rocky hillsides. Circumneutral. General.

Baptisia vespertina Rydb. Blue False Indigo.
Baptisia australis of auth., not R. Br. (G), (B & B).
Rocky prairies and glades. Calciphile to circumneutral. Central and southern Mo.: St. Louis, Jefferson, Franklin, St. Francois, Ste. Genevieve, Ozark, Taney, Stone, Barry, Greene, Hickory, Cedar, Vernon, Jasper, and Newton counties, and also introduced in Jackson Co.

Baptisia leucophaea Nutt.
Baptisia bracteata of auth., not (Muhl.) Ell. (G), (B & B).
Rocky prairies, meadows, and open woods. Circumneutral. General.

Baptisia leucophaea var. **laevicaulis** Gray.
Sometimes found with the typical form. Central and southern Mo.

Baptisia leucophaea × vespertina.
Rarely found with the parent species. Jasper Co.

Baptisia sphaerocarpa Nutt.
Introduced from farther south, along railways. Circumneutral. Scattered: St. Louis and Barry counties.

Cladrastis lutea (Michx. f.) Koch. Yellow Wood.
Along high rocky bluffs of White River and its tributaries. Circumneutral to calciphile. Southwestern Mo.: Taney, Stone, and Barry counties.

Crotalaria sagittalis L. Rattle-box.
Prairies, glades, and open sandy or rocky ground. Circumneutral to oxylophile. General.

TRIFOLIUM ARVENSE L. Rabbit-foot Clover.
Waste ground and along roadsides and railroads. Indifferent. Scattered: St. Louis, Phelps, Texas, Greene, Barry, and Jasper counties.

TRIFOLIUM INCARNATUM L. Crimson Clover.
Fields and waste ground. Indifferent. Scattered in middle and southeastern Mo.: Boone, St. Louis, Jefferson, Ste. Genevieve, Bollinger, Iron, Dunklin, Ripley, and Oregon counties.

TRIFOLIUM PRATENSE L. Red Clover.
Fields, meadows, waste and cultivated ground. Indifferent. General and common.

Trifolium reflexum L. Buffalo Clover.
Rocky open woods, glades, and prairies. Oxylophile to circumneutral. Northwestern, central, and southern Mo.: St. Louis, Jefferson, St. Francois, Ste. Genevieve, Iron, Madison, Bollinger, Wayne, Carter, Ripley, Oregon, Washington,

Howell, Shannon, Texas, Dent, Crawford, Maries, Phelps, Cooper, Morgan, Webster, Douglas, Atchison, Johnson, Greene, and Jasper counties.

Trifolium reflexum var. **glabrum** Lojacono.

Frequently occurring with the typical form, in similar situations. Central, southern, and western Mo.: Warren, St. Louis, Jefferson, Franklin, Phelps, Cole, Atchison, Jackson, Cass, Webster, Greene, Barry, and Jasper counties.

Trifolium stoloniferum Muhl. Running Buffalo Clover.

Open woods and prairies. Circumneutral. Central and southern Mo., scattered: Boone, St. Louis, Wayne, and Jasper counties.

Trifolium repens L. White Clover.

Fields, pastures, and waste ground. Indifferent. General and common.

TRIFOLIUM HYBRIDUM L. Alsike Clover.

Fields, roadsides, and waste ground. General and common.

Trifolium carolinianum Michx.

Glades and rocky prairies. Circumneutral to oxylophile. Southwestern Mo.: Jasper and Newton counties.

TRIFOLIUM AGRARIUM L. Yellow Hop Clover.

Fields and waste ground. Scattered: St. Charles and Christian counties.

TRIFOLIUM PROCUMBENS L. Low Hop Clover.

Rocky open ground, roadsides, and waste ground: Circumneutral. Eastern, central, and southern Mo. south of a line from Marion and Boone counties to Caldwell Co.

TRIFOLIUM DUBIUM Sibth. Little Hop Clover.

Roadsides and waste ground. Indifferent. Scattered: Boone, Johnson, Greene, and Jasper counties.

TRIFOLIUM RESUPINATUM L.

Waste and cultivated ground. Introduced in Johnson Co.

MELILOTUS OFFICINALIS (L.) Lam. Yellow Sweet Clover.

Along roadsides, railroads, and in waste ground. Indifferent. General. Recently introduced in many places.

MELILOTUS ALBA Desf. White Sweet Clover.

Roadsides, railroads, and waste ground. Indifferent. General and common.

MEDICAGO SATIVA L. Alfalfa.

Commonly cultivated in recent years, and often escaping along railroads and roadsides. Indifferent. General.

MEDICAGO LUPULINA L. Black Medick.

Roadsides and waste ground. Indifferent. General.

MEDICAGO HISPIDA Gaertn. Bur Clover.

Introduced along railroads and in waste ground. Jackson Co.

LOTUS CORNICULATUS L. Ground Honeysuckle.

Waste and cultivated ground. Introduced in Boone and Clay counties.

Lotus americanus (Nutt.) Bisch. Prairie Trefoil.

Hosackia americana (Nutt.) Piper (G), (B & B).

Prairie swales and glades, and also frequently adventized along roadsides and

railroads. Circumneutral. Central and southern Mo.; mostly in the western prairie region: Jefferson, Saline, Jackson, Henry, Vernon, Barton, Jasper, Newton, and McDonald counties.

Psoralea Onobrychis Nutt. French Grass.

Open woods, low alluvial thickets, and river banks. Circumneutral. Northeastern and east-central Mo.: Clark, Marion, Ralls, Shelby, St. Louis, Jefferson, and Franklin counties.

Psoralea pedunculata (Mill.) Vail.

Open rocky woods, glades, and prairies. Circumneutral to oxylophile. Central and southern Mo.: St. Louis, Jefferson, Franklin, St. Francois, Washington, Crawford, Iron, Dent, Shannon, Reynolds, Phelps, Maries, Pulaski, Texas, Laclede, Howell, Camden, Wright, Webster, Douglas, Hickory, Greene, Lawrence, Bates, Vernon, Jasper, Newton, and McDonald counties.

Psoralea tenuiflora Pursh. Scurfy Pea.

Psoralea tenuiflora var. *floribunda* (Nutt.) Rydb. (G).

Psoralea floribunda Nutt. (B & B).

Glades, rocky or open prairies, and open woods. Calciphile to circumneutral. Southern and central Mo. north to Monroe, Daviess, and Clinton counties.

Psoralea argophylla Pursh.

Prairies and loess hills. Calciphile to circumneutral. Northwestern and west-central Mo.: Atchison, Holt, and Jackson counties.

Psoralea esculenta Pursh. Prairie Turnip, Indian Bread-root.

Rocky prairies and glades. Calciphile to circumneutral. Central and southern Mo.: St. Louis, Jefferson, Franklin, Miller, Dallas, Greene, Ozark, Taney, Cedar, Jackson, and Bates counties.

Dalea alopecuroides Willd.

Parosela leporina (Ait.) Rydb. var. *alba* (Michx.) Macbride, Contr. Gray Herb. 65: 17. 1922.

Parosela Dalea (L.) Britton (B & B).

Loess hills, sandy open ground, and alluvial ground along rivers. Circumneutral. Northern, central, and eastern Mo., scattered: Putnam, Boone, St. Louis, Jefferson, Mississippi, Atchison, Holt, Andrew, Buchanan, Clay, Jackson, Cass, and Johnson counties.

Dalea enneandra Nutt.

Parosela enneandra (Nutt.) Britton (B & B).

Loess hills and plains. Calciphile to circumneutral. Northwestern Mo.: Atchison and Holt counties.

Petalostemum purpureum (Vent.) Rydb. Red Tassel-flower, Prairie Clover.

Prairies, glades, and rocky hillsides. Calciphile to circumneutral. General.

Petalostemum purpureum var. **pubescens** Gray.

Occasionally found with the typical form. Scattered: Shannon, Taney, Barry, Jasper, and McDonald counties.

Petalostemum multiflorum Nutt.

Rocky prairies and along railroads. Adventized from farther west. Jackson Co.

Petalostemum candidum Michx. White Tassel-flower, White Prairie Clover.

Prairies, glades, and rocky hillsides. Calciphile to circumneutral. General.

Tephrosia virginiana (L.) Pers. Goat's Rue, Hoary Pea.

Rocky open woods, prairies, and glades. Circumneutral to oxylophile. General: common in the Ozark region and scattered northward; known north of the Missouri River in Putnam, Monroe, Warren, Boone, and Howard counties.

Tephrosia virginiana var. **holosericea** (Nutt.) T. & G.

Occasionally found with the typical form. Dallas and Cedar counties.

Sesbania macrocarpa Muhl.

Low sandy fields and sand bars of streams. Oxylophile. Southern Mo., in the southeastern lowlands and locally along White River: Mississippi, New Madrid, Pemiscot, Dunklin, and Barry counties.

Wisteria macrostachya Nutt.

Low woods along streams, and borders of swamps and bayous. Circumneutral. Southeastern Mo.: Scott, Mississippi, Pemiscot, Dunklin, Butler, and Ripley counties, and also escaped from cultivation in Adair Co.

Wisteria frutescens (L.) Poir.

Cultivated, and escaped in Daviess Co.

Robinia Pseudo-Acacia L. Black Locust.

Rocky upland woods, pastures, and waste ground. Circumneutral. General; native in parts of the Ozark region and escaped from cultivation elsewhere.

Astragalus caryocarpus Ker. Ground Plum.

Prairies and glades. Circumneutral to calciphile. Western Mo., scattered: Atchison, Jackson, Vernon, Greene, and Jasper counties.

Astragalus mexicanus A. DC. Ground Plum.

Rocky prairies, glades, ledges along bluffs, and rocky open woods. Calciphile to circumneutral. Central and southern Mo., south and east of a line drawn from St. Charles, Montgomery, Boone, Morgan, and Henry counties to Jasper Co.

Astragalus canadensis L. Rattle Weed.

Open woods, thickets, and prairies. Circumneutral. General: Schuyler, Knox, Marion, Ralls, St. Charles, St. Louis, Jefferson, Mississippi, Ripley, Oregon, Shannon, Texas, Howell, Phelps, Pulaski, Miller, Morgan, Boone, Sullivan, Linn, Mercer, Harrison, Atchison, Dekalb, Jackson, St. Clair, Dallas, Greene, Cedar, Stone, and Jasper counties.

Astragalus distortus T. & G.

Rocky prairies and glades. Calciphile to circumneutral. General but scattered: Marion, Ralls, Monroe, St. Louis, Jefferson, Franklin, Scott, Butler, Shannon, Moniteau, Miller, Montgomery, Boone, Livingston, Jackson, Cass, Johnson, Hickory, Polk, Vernon, Dade, Greene, Jasper, and McDonald counties.

Astragalus lotiflorus Hook.

Loess hills and plains. Calciphile to circumneutral. Northwestern Mo.: Atchison and Holt counties.

Oxytropis plattensis Nutt. Loco Weed.

Oxytropis Lamberti Pursh (G), (B & B).

Loess hills. Calciphile. Northwestern Mo.: Atchison and Holt counties.

Amorpha fruticosa L. False Indigo.

Low open woods, thickets, and banks of streams. Circumneutral. General and probably in every county.

Amorpha fruticosa var. **tennesseensis** (Shuttlw.) Palmer, Jour. Arnold Arb. **12**: 192, *fig. 20b.* 1931.

Amorpha tennesseensis Shuttlw.

Rocky banks and moist ground along prairie streams. Circumneutral. Southern Mo.: Shannon, Ozark, Taney, Stone, Barry, Jasper, and McDonald counties.

Amorpha fruticosa var. **angustifolia** Pursh.

Wet ground along streams and borders of ponds. Circumneutral. Central and southern Mo.

Amorpha fruticosa var. **oblongifolia** Palmer, Jour. Arnold Arb. **12**: 192, *fig. 20c.* 1931.

Wet ground, thickets, and along prairie streams. Circumneutral. Western Mo.: Atchison and Jasper counties.

Amorpha croceolanata Wats.

Sandy open ground. Circumneutral to oxylophile. Southeastern Mo.: Dunklin Co.

Amorpha canescens Pursh. Lead Plant.

Rocky open woods, prairies, and glades. Oxylophile to circumneutral. General.

Amorpha canescens var. **glabrata** Gray.

Rocky open woods, bluffs, and glades. Oxylophile to circumneutral. Central and southern Mo.: Maries, Boone, Macon, Benton, Hickory, Dallas, Morgan, Ozark, Stone, and Jasper counties.

Amorpha brachycarpa Palmer, Jour. Arnold Arb. **12**: 171, *pl. 36. fig. 6.* 1931.

Rocky open woods and glades. Circumneutral. Southwestern Mo.: Stone Co.

Glycyrrhiza lepidota (Nutt.) Pursh. Wild Liquorice.

Loess hills, prairies, and waste ground. Calciphile to circumneutral. Native in northwestern Mo. and introduced in other parts of the state. Scattered: Marion, St. Louis, Jefferson, Moniteau, Gentry, Atchison, Holt, Andrew, Jackson, and Jasper counties.

CORONILLA VARIA L. Crown Vetch.

Roadsides and waste ground. Circumneutral. St. Louis and Taney counties. Introduced near St. Louis by Fendler.

Desmodium acuminatum (Michx.) DC. Beggar's Lice, Beggar's Ticks.

Desmodium grandiflorum (Walt.) DC. (G).

Meibomia grandiflora (Walt.) Ktze. (B & B).

Rocky open or rich low woods and bluffs. Circumneutral. General.

Desmodium nudiflorum (L.) DC. Tick Trefoil.

Rocky woods. Oxylophile. Central and southern Mo., south of a line drawn from Ralls and Randolph counties to Jackson Co.

Desmodium pauciflorum (Nutt.) DC.

Rich or rocky woods and thickets. Circumneutral. Central and southern Mo.: Boone, Franklin, St. Louis, Jefferson, Scott, Mississippi, New Madrid, Dunklin, Stoddard, Butler, Ripley, Pulaski, Greene, Jasper, and Newton counties.

Desmodium rotundifolium (Michx.) DC.

Rocky open woods. Oxylophile. Central and southern Mo., south and east of a line drawn from St. Louis, Warren, Boone, Morgan, and Hickory counties to Jasper Co.

Desmodium ochroleucum M. A. Curtis.

Open woods and low open ground. Circumneutral. Southeastern Mo.: Stoddard and Shannon counties.

Desmodium canescens (L.) DC. Beggar's Lice, Beggar's Ticks.

Dry open woods and thickets. Circumneutral to oxylophile. General.

Desmodium canescens var. **hirsutum** (Hook.) Robinson.

In similar situations to the typical form. Circumneutral to oxylophile. Scattered: St. Louis, Jefferson, Butler, Boone, Texas, Greene, Jasper, and Jackson counties.

Desmodium bracteosum (Michx.) DC.

Dry open woods and thickets. Circumneutral to calciphile. General.

Desmodium bracteosum var. **longifolium** (T. & G.) Robinson.

In similar situations to the typical form. Scattered: Marion, St. Louis, Gentry, Boone, Jackson, and Jasper counties.

Desmodium illinoense Gray.

Prairies, glades, and rocky, open woods. Circumneutral to oxylophile. Northern, central, and western Mo., absent from the Ozark region.: Adair, Lewis, Marion, Ralls, Monroe, Crawford, Boone, Saline, Pettis, Worth, Gentry, Dekalb, Clinton, Caldwell, Jackson, Greene, and Jasper counties.

Desmodium laevigatum (Nutt.) DC.

Rocky open woods. Circumneutral to oxylophile. Eastern and southern Mo.: Ralls, Ste. Genevieve, Iron, Reynolds, Shannon, Phelps, Pulaski, Douglas, Ozark, Taney, Barry, and Jasper counties.

Desmodium viridiflorum (L.) Beck.

Open woods, glades, and rocky prairies. Circumneutral to oxylophile. Southern Mo.: Scott, Dunklin, Ripley, Shannon, Howell, Barry, and McDonald counties.

Desmodium Dillenii Darl.

Rocky open woods, thickets, and glades. Oxylophile to circumneutral. General.

Desmodium paniculatum (L.) DC.

Rich woods and thickets and alluvial ground. Circumneutral to calciphile. General.

Desmodium paniculatum var. **pubens** T. & G.

In similar situations to the typical form. General.

Desmodium paniculatum var. **angustifolium** T. & G.

In similar situations to the typical form. General.

Desmodium sessilifolium (Torr.) T. & G.

Rocky open woods, prairies, and glades. Circumneutral to calciphile. General.

Desmodium canadense (L.) DC.

Prairies and open thickets. Circumneutral. Northern, central, and western Mo., apparently absent from the Ozark region: Clark, Schuyler, St. Louis, Mercer, Saline, Jackson, and Jasper counties.

Desmodium rigidum (Ell.) DC.

Rocky woods, glades, and prairies. Oxylophile to circumneutral. Southern and central Mo.: Lincoln, St. Louis, Jefferson, St. Francois, Dunklin, Butler, Iron, Dent, Crawford, Pulaski, Cole, Howell, Moniteau, Boone, Douglas, Taney, Barry, Jasper, Newton, and McDonald counties.

Desmodium obtusum (Muhl.) DC.

Dry open woods, glades, and sandy or rocky open ground. Oxylophile. Central and southern Mo.: Boone, St. Louis, Jefferson, Scott, Mississippi, Dunklin, Stoddard, Reynolds, Shannon, Dent, Phelps, Pulaski, Howell, Maries, Dallas, Hickory, Henry, Pettis, Greene, Ozark, Stone, Barry, Jasper, and McDonald counties.

Desmodium marilandicum (L.) DC.

Dry open woods and thickets. Oxylophile. Central and southern Mo.: Montgomery, Warren, Lincoln, St. Louis, Jefferson, Franklin, Iron, Wayne, Ripley, Reynolds, Dent, Crawford, Maries, Phelps, Pulaski, Camden, Greene, Taney, Stone, Barry, Jackson, Jasper, Newton, and McDonald counties.

Desmodium canadense × Dillenii.

Rarely found with the parent species. Local: St. Louis Co.

Lespedeza procumbens Michx. Bush Clover.

Dry rocky woods. Oxylophile to circumneutral. Southern and central Mo. south and east of a line drawn from St. Louis, Boone, and Hickory counties to Jasper Co.

Lespedeza repens (L.) Bart.

Rocky open woods. Oxylophile to circumneutral. Southern and central Mo. south of a line drawn from Lincoln, Boone, and Saline counties to Cass Co.

Lespedeza violacea (L.) Pers. Bush Clover.

Lespedeza violacea var. *prairea* Mack. & Bush (G).

Rocky or dry open woods, thickets, and rocky prairies. Circumneutral. General.

Lespedeza Manniana Mack. & Bush.

Rocky woods and glades. Circumneutral. Scattered in central and southern Mo.: Jefferson, Newton, and Jackson counties. Probably a hybrid between *Lespedeza virginica* and *L. capitata.*

Lespedeza Stuevei Nutt. See Rh. **26**: 28. 1924.

Dry open woods, thickets, and prairies. Oxylophile to circumneutral. Southern Mo.: Ste. Genevieve, Scott, Mississippi, Stoddard, Dunklin, Shannon, Phelps, Pulaski, Howell, Ozark, Taney, Vernon, Barry, Jasper, Newton, and McDonald counties.

Lespedeza Stuevei var. **angustifolia** Britton. See Rh. **26**: 29. 1924.

Lespedeza Stuvei var. *neglecta* Britton (G).

Occasionally found with the typical form. Scattered in southern and central Mo.: St. Louis, Iron, and Pulaski counties. Probably a hybrid between *Lespedeza virginica* and *Lespedeza Stuevei.*

Lespedeza virginica (L.) Britton. Bush Clover.

Rocky or dry open woods, thickets, prairies, and glades. Circumneutral to oxylophile. General and common.

Lespedeza intermedia (Wats.) Britton. See Rh. **26**: 29–31. 1924.

Lespedeza frutescens Britton, not *Hedysarum frutescens* L. (G), (B & B).

Rocky open woods and thickets. Circumneutral to oxylophile. Southern and east-central Mo.: St. Louis, Ste. Genevieve, Bollinger, Iron, Butler, Reynolds, Shannon, Dent, Phelps, Henry, Taney, Stone, Barry, Jasper, and McDonald counties.

Lespedeza simulata Mack. & Bush.

Dry open woods and rocky prairies. Circumneutral. Southwestern Mo.: Barry, Jasper and Newton counties. Probably a hybrid between *Lespedeza virginica* or *Lespedeza Stuevei* and *Lespedeza capitata.*

Lespedeza acuticarpa Mack. & Bush.

Rocky open woods, prairies, and glades. Circumneutral. Southern and western Mo.: Iron, Shannon, Barry, and Jackson counties. Probably a hybrid between *Lespedeza virginica* or *Lespedeza frutescens* and *Lespedeza violacea.*

Lespedeza Nuttallii Darl.

Dry rocky woods and thickets. Circumneutral to oxylophile. Southern Mo.: Iron, Phelps, Miller, Wright, and Jasper counties.

Lespedeza hirta (L.) Hornem. Hairy Bush Clover.

Rocky open woods, thickets, and glades. Oxylophile. Central and southern Mo. south and east of a line drawn from St. Louis, Warren, Morgan, and Cedar counties to Barton Co.

Lespedeza capitata Michx.

Rocky prairies, thickets, and glades. Oxylophile to circumneutral. General.

Lespedeza capitata var. **longifolia** (DC.) T. & G.

Sometimes found with the typical form. Scattered: St. Louis, Jackson, and Jasper counties.

Lespedeza capitata var. **sericea** H. & A.

In similar situations to the typical form, and in many places more common. Circumneutral. General.

LESPEDEZA STRIATA (Thunb.) H. & A. Japanese Clover.

Dry open woods and roadsides; generally in rocky or gravelly ground. Oxylophile. Eastern, southern, and central Mo.

LESPEDEZA STIPULACEA Maxim. Corean Clover.

Open woods, roadsides, and waste ground. Indifferent. General. Recently introduced and being planted in many places along roadsides for a ground cover, and likely to spread widely as an introduced species.

Stylosanthes biflora (L.) BSP.

Rocky open woods, prairies, and glades. Oxylophile to circumneutral. Central and southern Mo.: Boone, Lincoln, St. Charles, St. Louis, Jefferson, Franklin, Washington, Iron, Reynolds, Dunklin, Ripley, Oregon, Shannon, Dent, Maries, Texas, Howell, Laclede, Wright, Taney, Stone, Greene, Polk, Hickory, Ozark, Jackson, Vernon, Barton, Jasper, Newton, McDonald, and Barry counties.

Stylosanthes biflora var. **hispidissima** (Michx.) Pollard & Ball.

Similar situations to the preceding. Oxylophile to circumneutral. Central and southern Mo.: Mississippi, Iron, Reynolds, Carter, Oregon, Howell, Douglas, Dent, Maries, Pulaski, Boone, Henry, Laclede, Dallas, Hickory, Greene, Stone, Barry, and McDonald counties.

VICIA SATIVA L. Spring Vetch.

Waste ground and roadsides. Escaped from cultivation. Indifferent. Scattered: St. Louis, Jefferson, and Jackson counties.

VICIA VILLOSA Roth. Winter Vetch.

Fields, waste ground, and roadsides. Indifferent. Scattered: Boone, St. Louis, Jefferson, Texas, Howell, Livingston, Clay, and Jasper counties.

Vicia ludoviciana Nutt.

Rich rocky woods. Circumneutral. Southwestern Mo.: Greene and McDonald counties.

Vicia caroliniana Walt.

Rich woods and alluvial banks. Oxylophile to circumneutral. East-central and southern Mo.: Franklin, Washington, Bollinger, Madison, Wayne, Reynolds, Carter, Ripley, Oregon, Howell, Texas, Phelps, Pulaski, Dallas, Wright, Douglas, Greene, Christian, Taney, Barry, Newton, and McDonald counties.

Vicia americana Muhl.

Open woods and thickets. Circumneutral. Northern and central Mo.: St. Louis, Jefferson, Atchison, Holt, Platte, Jackson, and Bates counties.

VICIA ANGUSTIFOLIA (L.) Reichard.

Fields and waste ground. Indifferent. Introduced in Boone and Jackson counties.

VICIA MICRANTHA Nutt.

Thickets and prairies. Circumneutral. Introduced in Jackson Co.

VICIA TETRASPERMA (L.) Moench.

Roadsides and waste ground. Indifferent. Introduced in Jackson Co.

Lathyrus venosus Muhl. var. **intonsus** Butters & St. John, Rh. **19**: 158. 1917. Bushy Vetch.

Rocky open woods. Circumneutral. East-central and southern Mo.: St. Louis, Crawford, Wayne, Carter, Shannon, Howell, and Barry counties.

Lathyrus pusillus Ell.

Rocky open woods and chert glades. Oxylophile. Southwestern Mo.: Jasper and Newton counties.

Lathyrus palustris L. See Rh. **13**: 50. 1911. Marsh Pea.

Open woods and moist banks. Circumneutral. Central Mo., scattered: Boone, Ray, and Jackson counties.

Lathyrus palustris var. **myrtifolius** (Muhl.) Gray.

Open woods and moist banks. Oxylophile to circumneutral. Central and southeastern Mo.: Boone, St. Louis, Jefferson, Scott, and Iron counties.

Apios americana Medic. See Rh. **36**: 88–89. 1934. Groundnut.

Apios tuberosa Moench (G), (B & B).

Thickets and borders of streams. Circumneutral to oxylophile. General.

Phaseolus polystachyus (L.) BSP. Wild Bean.

Rocky open woods and thickets. Circumneutral. East-central and southern Mo.: St. Louis, Jefferson, Iron, Dunklin, Ripley, Phelps, Pulaski, Dallas, Douglas, Greene, Jasper, and McDonald counties.

VIGNA SINENSIS (L.) Endl. Cow Pea.

Occasionally escaped from cultivation. Jackson Co.

Strophostyles helvola (L.) Britton.

Rich rocky woods and thickets. Circumneutral. General.

Strophostyles helvola var. **missouriensis** (Wats.) Britton.

Moist alluvial ground, woods, and thickets. Circumneutral. General but scattered: Clark, Boone, Gasconade, Lincoln, St. Charles, St. Louis, Jefferson, Mississippi, New Madrid, Pemiscot, Dunklin, Butler, Clay, Jackson, and Dekalb counties.

Strophostyles umbellata (Muhl.) Britton.

Moist woods and thickets. Circumneutral to oxylophile. General but scattered: Clark, Marion, Boone, St. Louis, Jefferson, Ste. Genevieve, Iron, Dunklin, Butler, Shannon, Phelps, Taney, Clay, and Jasper counties.

Strophostyles pauciflora (Benth.) Wats.

Open woods, thickets, and prairies. Circumneutral to oxylophile. General.

Clitoria mariana L. Turkey Pea, Butterfly Pea.

Rocky open woods and glades. Oxylophile. Southern Mo.: Ste. Genevieve, Madison, Iron, Wayne, Reynolds, Carter, Shannon, Howell, Douglas, Taney, Stone, Barry, Newton, and McDonald counties.

Amphicarpa bracteata (L.) Fernald, Rh. **35**: 276. 1933. Hog Peanut.

Amphicarpa monoica (L.) Ell. (G).

Falcata comosa (L.) Ktze. (B & B).

Open woods and thickets. Circumneutral to oxylophile. General.

Amphicarpa comosa (L.) G. Don. See Rh. **35**: 276. 1933.

Amphicarpa Pitcheri T. & G. (G).

Falcata Pitcheri (T. & G.) Ktze. (B & B).

Moist rich woods and thickets. Circumneutral. General but scattered: Marion, Ralls, Pike, St. Louis, Jefferson, Iron, Reynolds, Shannon, Phelps, Cole, Boone, Randolph, Grundy, Clinton, Platte, Jackson, Cass, Greene, Taney, and Jasper counties.

Galactia regularis (L.) BSP. Milk Pea.

Thickets and open woods along streams. Circumneutral to oxylophile. Southeron Mo.: Dunklin, Butler, Shannon, and Barry counties.

Galactia volubilis (L.) Britton var. **mississippiensis** Vail.

Rocky woods, slopes, and glades. Oxylophile. Eastern and southern Mo., mostly in the Ozark region: Knox, St. Charles, Jefferson, Ste. Genevieve, Perry, Dunklin, Butler, Scott, Bollinger, Ripley, Oregon, Wayne, Shannon, Reynolds, Dent, Phelps, Pulaski, Texas, Howell, Douglas, Taney, Barry, Dallas, Jasper, and McDonald counties.

Rhynchosia tomentosa (L.) H. & A.

Dolicholus tomentosus (L.) Vail (B & B).

Sandy open ground. Oxylophile. Southeastern Mo.: Dunklin Co.

Rhynchosia latifolia Nutt.

Dolicholus latifolius (Nutt.) Vail (B & B).

Sandy prairies, thickets, and rocky open woods along streams. Oxylophile. Southern Mo.: Mississippi, Stoddard, Dunklin, Ripley, Ozark, and McDonald counties.

Fam. Oxalidaceae

Oxalis violacea L. Sheep Sour, Wood Sorrel.

Rocky open woods, glades, and rocky prairies. Circumneutral. General.

Oxalis florida Salisb. var. **strigosifolia** Wiegand, Rh. **27**: 134. 1925.

Oxalis filipes Small, in part (G).

Open woods and thickets. Oxylophile. Southeastern Mo., local: Ripley Co.

Oxalis europaea Jord. See Rh. **27**: 134. 1925. Lady's Sorrel.

Oxalis corniculata of Am. auth., not L. (G).

Xanthoxalis corniculata (L.) Small (B & B).

Open woods, thickets, fields, and waste ground. Circumneutral. General and common.

Oxalis europaea f. **pilosella** Wiegand, Rh. **27**: 135. 1925.

Similar situations to the last. Oxylophile. Scattered: St. Louis, Boone, and Jackson counties.

Oxalis europaea f. **villicaulis** Wiegand, Rh. **27**: 135. 1925.

Frequently occurring with the other forms. St. Louis, Jefferson, and Douglas counties.

Oxalis europaea f. **cymosa** (Small) Wiegand, Rh. **27**: 135. 1925.

Oxalis cymosa Small.

Xanthoxalis cymosa Small (B & B).

Rocky open woods, fields, and waste ground. Circumneutral. General.

Oxalis europaea var. **Bushii** (Small) Wiegand, Rh. **27**: 135. 1925.

Oxalis Bushii Small.

Xanthoxalis Bushii Small (B & B).

Oxalis interior (Small) Fedde.

Xanthoxalis interior Small (B & B).

Open woods and rocky waste ground. Circumneutral. Southern and central Mo.: Jefferson, Boone, Jackson, Johnson, Newton, and Jasper counties.

Oxalis europaea var. **Bushii** f. **subglabrata** Wiegand, Rh. **27**: 136. 1925.

Occasionally found with the typical and other forms. Jackson Co.

Oxalis stricta L. Sheep Sorrel, Yellow Wood Sorrel.

Rocky open woods, prairies, fields, and glades. Circumneutral. General.

Oxalis stricta var. **piletocarpa** Wiegand, Rh. **27**: 123. 1925.

Prairies, open thickets, and glades. Circumneutral. General.

Oxalis corniculata L. See Rh. **27**: 120. 1925.

Oxalis repens Thunb. (G).

Xanthoxalis corniculata (L.) Small, in part (B & B).

Fields and waste ground, and frequently about greenhouses and gardens. Indifferent. Scattered: St. Louis, Jefferson, St. Francois, Boone, Jackson, and Jasper counties.

Oxalis corniculata var. **viscidula** Wiegand, Rh. **27**: 121. 1925.
Commonly occurring with the typical form. Oxylophile. St. Louis and Jackson counties.

Oxalis pilosa Nutt. var. **Wrightii** (Gray) Wiegand, Rh. **28**: 67. 1926.
Open and waste ground. Oxylophile. Introduced in Jackson Co.

Fam. Geraniaceae

Geranium maculatum L. Wild Geranium, Cranesbill.
Rich or rocky open woods, and thickets. Circumneutral. General.

Geranium carolinianum L.
Meadows, prairies, glades, and waste ground. Circumneutral to oxylophile. General.

Geranium carolinianum var. **confertiflorum** Fernald, Rh. **37**: 300. 1935.
Similar situations to the preceding. Oxylophile. General.

Geranium pusillum Burm. f.
Rocky open ground. Circumneutral. Southwestern Mo., local: McDonald Co.

Erodium cicutarium (L.) L'Her. Pink Needle, Storksbill.
Open and waste ground. Circumneutral. Introduced in Boone and Platte counties.

Fam. Linaceae

Linum medium (Planch.) Britton.
Prairies, rocky woods, and glades. Circumneutral. Central and southern Mo.: Boone, Callaway, St. Louis, Jefferson, Franklin, Washington, Ste. Genevieve, St. Francois, Madison, Iron, Reynolds, Ripley, Oregon, Shannon, Dent, Phelps, Camden, Wright, Polk, Hickory, Cedar, St. Clair, Greene, Ozark, Taney, Barry, Vernon, Barton, Jasper, Newton, and McDonald counties.

Linum rigidum Pursh.
Rocky and waste ground. Circumneutral. Introduced in Jackson Co.

Linum sulcatum Riddell.
Rocky prairies, glades, and open woods. Circumneutral. General.

Linum striatum Walt.
Moist woods, bogs, and wet sandy open ground. Oxylophile to circumneutral. Eastern Mo., south of the Missouri River; Franklin, Jefferson, Ste. Genevieve, Perry, Iron, Bollinger, Scott, Dunklin, Butler, and Ripley counties.

Linum usitatissimum L. Flax, Linseed.
Cultivated and frequently adventive along railroads and roadsides. Indifferent. Scattered: Boone, Warren, St. Louis, Franklin, Saline, Clay, Jackson, Greene, Barton, and Jasper counties.

Fam. Zygophyllaceae

Tribulus terrestris L. Caltrop.
Waste ground. Indifferent. Scattered: St. Louis, Franklin, Boone, Moniteau, Atchison, Andrew, and Jackson counties.

Kallstroemia intermedia Rydb.

Kallstroemia maxima (L.) T. & G. (G).

Waste ground. Oxylophile. Scattered: Jefferson, Jackson, and Jasper counties.

Fam. Rutaceae

Zanthoxylum americanum Mill. Prickly Ash.

Thickets and open rocky woods. Circumneutral to calciphile. General, although apparently absent from parts of the Ozark region.

Ruta graveolens L. Rue.

Planted in old gardens and occasionally escaped into waste ground. Indifferent. Franklin Co.

Ptelea trifoliata L. Hop Tree, Wafer Ash.

Rocky thickets and glades. Circumneutral to oxylophile. Eastern, central, and southern Mo., and locally in Atchison Co., in the northwestern part. Commonest in the Ozark region.

Fam. Simarubaceae

Ailanthus altissima (Mill.) Swingle, Jour. Wash. Acad. Sci. 6: 495. 1916. Tree of Heaven.

Ailanthus glandulosa Desf. (G), (B & B).

A Chinese tree commonly planted and escaping in many places. Thickets and along streams. Scattered: St. Louis, Ripley, Jackson, Greene, and Jasper counties.

Fam. Polygalaceae

Polygala Senega L. Seneca Snakeroot.

Rocky open woods, thickets, and clearings. Oxylophile to circumneutral. Scattered: Schuyler, Sullivan, Dent, and Ozark counties.

Polygala Senega var. **latifolia** T. & G.

In similar situations to the typical form and more common. Oxylophile to circumneutral. Southern Mo.: Iron, Reynolds, Carter, Ripley, Oregon, Shannon, Dent, Phelps, Wright, Webster, Douglas, Ozark, Taney, Dallas, Hickory, Polk, Greene, Stone, Barry, and McDonald counties.

Polygala incarnata L. Pink Milkwort.

Prairies and glades. Circumneutral to oxylophile. Southern and western Mo.: Dent, Texas, Greene, Clinton, Jackson, Cass, Henry, Vernon, Jasper, Newton, and McDonald counties.

Polygala sanguinea L. Field Milkwort.

Prairies, glades, and meadows. Circumneutral. General.

Polygala verticillata L.

Open woods, thickets, and glades. Circumneutral to oxylophile. General: Sullivan, Clark, Boone, St. Charles, St. Louis, Jefferson, Washington, Crawford, Wayne, Reynolds, Shannon, Dent, Wright, Greene, Stone, Polk, Morgan, Saline, Atchison, Holt, Jackson, Jasper, Newton, and McDonald counties.

Polygala verticillata var. **ambigua** (Nutt.) Wood.

Rocky woods and glades. Oxylophile. Southern Mo.: Washington, Iron, Dent, Shannon, Texas, Howell, Greene, Stone, Barry, and McDonald counties.

Polygala verticillata var. **sphenostachya** Pennell, Bartonia 13: 12. 1932.

Limestone glades. Calciphile. Local: Jackson Co.

Fam. EUPHORBIACEAE

Croton glandulosus L. var. **septentrionalis** Muell. Arg.

Prairies, open woods, cultivated and waste ground. Oxylophile to circumneutral. General but commonest in central and southern Mo.

Croton capitatus Michx. Hogwort.

Prairies, glades, and waste ground. Circumneutral to oxylophile. General and common.

Croton monanthogynus Michx.

Dry prairies, barrens, glades, and waste ground. Circumneutral to oxylophile. General, except perhaps in parts of northern Mo.

Croton Engelmanni Ferg.

Open ground. Circumneutral to oxylophile. Southern Mo.: Scott, Mississippi, New Madrid, Pemiscot, Stoddard, Butler, Ripley, and Howell counties, and also adventized along railways in St. Louis and Moniteau counties.

Croton texensis (Klotzsch) Muell. Arg.

Introduced along railroads. Oxylophile. Jackson Co.

Crotonopsis elliptica Willd. See Bull. Torr. Bot. Club **45**: 478–479. 1919.

Crotonopsis linearis of auth. in part, not Michx. (G), (B & B).

Rocky open woods and glades. Oxylophile. East-central and southern Mo.: Lincoln, Montgomery, Warren, St. Charles, Gasconade, Franklin, St. Louis, Jefferson, St. Francois, Ste. Genevieve, Perry, Bollinger, Madison, Iron, Wayne, Shannon, Dent, Phelps, Crawford, Pulaski, Texas, Greene, Polk, St. Clair, Barry, Vernon, Jasper, Newton, and McDonald counties.

Crotonopsis linearis Michx.

Open sandy ground. Oxylophile. Southeastern Mo.: Stoddard and Dunklin counties.

MERCURIALIS ANNUA L. Mercury.

Introduced in waste ground. St. Louis Co.

Acalypha virginica L. Three-seeded Mercury.

Prairies, thickets, open woods, and cultivated and waste ground; usually in moist or wet ground. Circumneutral. General.

Acalypha digyneia Raf. See Rh. **29**: 198. 1927.

In similar situations to the preceding. Circumneutral. Eastern, central, and southern Mo.: Marion, St. Charles, St. Louis, Jefferson, St. Francois, Perry, Butler, Dent, Phelps, Pulaski, Cole, Dallas, Montgomery, Boone, Randolph, Saline, Linn, Clinton, Jackson, Barton, and Jasper counties.

Acalypha gracilens Gray var. **monococca** Engelm. See Rh. **29**: 203. 1927.

Acalypha gracilens of auth. in part, not Gray (G), (B & B).

Rocky prairies, open woods, and glades. Circumneutral. Eastern, central, and southern Mo., commonest in the Ozark region.

Acalypha ostryaefolia Riddell.

Moist open and cultivated ground. Circumneutral. East-central and southern Mo.: Gasconade, St. Louis, Jefferson, Perry, Mississippi, Reynolds, Howell, Ozark, Barry, and Jasper counties.

RICINUS COMMUNIS L. Castor-oil Plant.

Cultivated and sometimes adventive in waste ground. Indifferent. Scattered: Lincoln, St. Louis, Dunklin, Boone, Jackson, and Jasper counties.

Tragia urticaefolia Michx.

Tragia nepetaefolia of auth., not Torr. (B & B), in part.

Tragia ramosa of auth., not Torr. (B & B), in part.

Rocky prairies, open ground, and glades. Circumneutral. Central and southern Mo., mostly in the Ozark region.

Tragia cordata Michx.

Tragia macrocarpa Willd. (G), (B & B).

Rocky open woods, thickets, and glades. Oxylophile to circumneutral. Southern Mo.: Oregon, Stone, Taney, Greene, Barry, and McDonald counties.

Phyllanthus caroliniensis Walt.

Fields, thickets, and moist alluvial open ground. Circumneutral. Central and southern Mo.: Boone, St. Louis, Franklin, St. Francois, Scott, New Madrid, Dunklin, Ripley, Oregon, Shannon, Phelps, Barry, Vernon, Jasper, Newton, and McDonald counties.

Andrachne phyllanthoides (Nutt.) Muell. Arg.

Rocky ledges, glades, and bald knobs. Calciphile to circumneutral. Southern Mo.: Phelps, Shannon, Texas, Ozark, Christian, Taney, Stone, and Barry counties.

Euphorbia zygophylloides Boiss. Prairie Spurge.

Glades and rocky open ground. Calciphile to circumneutral. Western Mo., scattered: Jackson, Cass, Henry, Barry, and Greene counties.

Euphorbia serpens HBK.

Open ground, usually in rich alluvial soil. Calciphile to circumneutral. Northern and central Mo., scattered: St. Charles, St. Louis, Perry, Miller, Saline, Atchison, Andrew, Platte, Carroll, Jackson, and Henry counties.

Euphorbia glyptosperma Engelm.

Plains, sand bars, and open alluvial ground. Circumneutral. Northwestern and central Mo., scattered: St. Louis, Jefferson, Atchison, Holt, Buchanan, Platte, Clay, and Jackson counties.

Euphorbia nutans Lag. Nodding Spurge.

Euphorbia Preslii Guss. (G).

Thickets, fields, and waste ground. Circumneutral. General and common.

Euphorbia maculata L. Milk Purslane.

Cultivated and waste ground, and in glades. Indifferent. General and common.

Euphorbia humistrata Engelm.

Rocky open ground. Oxylophile. Eastern, central, and southern Mo., scattered: Marion, Lincoln, Boone, Cooper, Cole, Laclede, St. Louis, Jefferson. Franklin, Perry, Pemiscot, New Madrid, Barry, and Jackson counties.

Euphorbia marginata Pursh. Snow-on-the-mountain.

Native on loess hills and plains in northwestern Mo. and introduced in other parts of the state: Atchison, Holt, Jackson, Lafayette, Boone, Greene, Stone, Barton, and Jasper counties.

Euphorbia corollata L. Flowering Spurge.

Prairies, glades, and open rocky woods. Circumneutral. General.

Euphorbia dentata Michx.

Prairies, glades, and waste ground. Circumneutral. General.

Euphorbia heterophylla L. Painted-leaf.

Open rocky woods, thickets, glades, and alluvial soils. Circumneutral. General.

Euphorbia obtusata Pursh. Warty Spurge.

Moist woods and thickets. Circumneutral. East-central and southeastern Mo., mostly in the eastern Ozark region: Boone, St. Louis, Jefferson, Franklin, St. Francois, Washington, and Shannon counties.

Euphorbia dictyosperma Fisch. & Mey.

Tithymalus missouriensis (Norton) Small (B & B), in part.

Tithymalus arkansanus (Engelm. & Gray) Kl. & Garcke (B & B), in part.

Galarrhoeus missouriensis (Norton) Rydb. (S), (R).

Galarrhoeus arkansanus (Engelm. & Gray) Small (S), (R).

Rocky ledges, glades, and open ground. Calciphile to circumneutral. Scattered in western and middle Mo.: Boone, Clay, Jackson, St. Clair, Barry, Jasper, and McDonald counties.

Euphorbia commutata Engelm.

Rich rocky woods, and moist open ground. Circumneutral. East-central and southern Mo.: Montgomery, Warren, St. Louis, Jefferson, Franklin, Ste. Genevieve, St. Francois, Bollinger, Washington, Crawford, Iron, Reynolds, Wayne, Carter, Ripley, Oregon, Shannon, Texas, Dent, Phelps, Maries, Pulaski, Howell, Laclede, Wright, Douglas, Taney, Stone, Barry, and McDonald counties.

EUPHORBIA CYPARISSIAS L. Cypress Spurge.

Commonly planted in cemeteries and sometimes escaping to roadsides and fields. Indifferent. Scattered: Marion, St. Louis, Boone, and Jackson counties.

Fam. CALLITRICHACEAE

Callitriche deflexa A. Br. var. **Austini** (Engelm.) Hagelm.

Wet or damp open ground, around borders of ponds and swales, fields and waste places, mostly on alluvial soils. Circumneutral to oxylophile. Central and southern Mo.: Boone, Lincoln, St. Louis, Jefferson, Franklin, Ste. Genevieve, Dunklin, Shannon, Phelps, Maries, Texas, Webster, Laclede, Douglas, Greene, Jackson, Henry, Dade, Lawrence, Barton, and Jasper counties.

Callitriche heterophylla Pursh. Water Starwort.

Ponds, bayous, shallow water of slow streams, and in springs and spring branches. Circumneutral. General but scattered: Livingston, Clark, Randolph, Boone, Callaway, St. Louis, Jefferson, Perry, Wayne, Butler, Ripley, Dunklin, Reynolds, Shannon, Iron, Oregon, Howell, Texas, Dent, Crawford,

Pulaski, Dallas, Laclede, Greene, Ozark, Barry, Wright, Webster, Jackson, Barton, and Jasper counties.

Fam. Anacardiaceae

Rhus glabra L. Smooth Sumach.

Upland prairies, thickets, and borders of woods. Circumneutral. General and probably in every county.

Rhus copallina L.

Prairies, thickets, and open woods. Circumneutral to oxylophile. General, but commonest in southern Mo.

Rhus Toxicodendron L. Poison Ivy.

Thickets and open woods; commonest on alluvial soil and along streams. Circumneutral. General and probably in every county. Very variable in foliage and habit, but the shrubby and scandent forms are not clearly distinguishable.

Rhus quercifolia (Michx.) Steud. Poison Oak.

Rocky open woods and glades. Oxylophile. Southern Mo., rare and scattered: Mississippi and Ozark counties.

Rhus canadensis L. Pole-cat Bush, Fragrant Sumach.

Thickets, glades, and open woods. Circumneutral to calciphile. General.

Rhus canadensis var. **serotina** (Greene) Palmer & Steyermark, comb. nov. Pole-cat Bush.

Schmaltzia serotina Greene.

Rhus canadensis var. *trilobata* of auth., not *Rhus trilobata* Nutt. (G).

Thickets, glades, and rocky bluffs. Circumneutral to calciphile. General, but commonest in the Ozark region: Mercer, Putnam, Knox, Shelby, Ralls, Audrain, Boone, St. Francois, Wayne, Butler, Shannon, Texas, Phelps, Pulaski, Laclede, Maries, Cole, Moniteau, Morgan, Miller, Camden, Douglas, Ozark, Taney, Hickory, Polk, Greene, Stone, Jackson, Henry, St. Clair, Cedar, Barry, Jasper, Newton, and McDonald counties.

A stout, much-branched shrub, blooming much later than *R. canadensis*, and after the leaves are half grown. It differs from *Rhus trilobata* Nutt. in its larger, thinner, more obtusely lobed leaflets and larger fruit clusters, as well as in habit of growth.

Rhus canadensis var. **illinoensis** (Greene) Fernald.

Rocky bluffs and glades. Calciphile to circumneutral. Scattered: Putnam and Barry counties.

Cotinus americanus Nutt. Smoke Tree.

Rhus cotinoides Nutt. (G).

Rocky bluffs, glades, and bald knobs. Calciphile to circumneutral. Southwestern Mo.: Polk, Ozark, Taney, and Stone counties.

Fam. Aquifoliaceae

Ilex decidua Walt. Possum Haw.

Low woods and glades. Calciphile to circumneutral. Eastern, central, and southern Mo.: Lewis, Ralls, Pike, Lincoln, Montgomery, St. Charles, St. Louis,

Jefferson, Franklin, Gasconade, Perry, Cape Girardeau, Bollinger, Scott, Mississippi, New Madrid, Pemiscot, Dunklin, Stoddard, Butler, Wayne, Madison, Iron, Ripley, Oregon, Carter, Shannon, Cole, Miller, Howell, Ozark, Taney, Stone, Barry, St. Clair, Bates, and Jasper counties.

Ilex verticillata (L.) Gray var. **padifolia** (Willd.) T. & G. Black Alder, Winterberry.

Sandy bogs and along rocky streams. Oxylophile. Southeastern Mo.: Iron, Madison, and Reynolds counties.

Ilex opaca Ait. Christmas Holly.

Low wet woods and sandy bogs. Oxylophile. Southeastern Mo.: Cape Girardeau, Mississippi, New Madrid, Dunklin, Stoddard, Butler, and Wayne counties.

Fam. CELASTRACEAE

Evonymus atropurpureus Jacq. Burning Bush, Wahoo.

Thickets, banks of streams, and open woods. Circumneutral. General.

Evonymus americanus L. Strawberry Bush.

Low woods and moist banks of small streams. Oxylophile to circumneutral. Southeastern Mo.: Dunklin, Butler, and Ripley counties.

Evonymus obovatus Nutt. Running Strawberry Bush.

Shaded rocky bluffs. Circumneutral to calciphile. Southern Mo.: Madison, Shannon, Texas, Howell, and Stone counties.

Celastrus scandens L. Bitter-sweet.

Thickets and fence rows. Circumneutral. General.

Fam. STAPHYLEACEAE

Staphylea trifolia L. Bladder-nut, Rattle-box.

Rich woods, thickets, and along bluffs. Circumneutral. General.

Fam. ACERACEAE

Acer saccharum Marsh. Sugar Maple.

Bluffs and woods along streams. Circumneutral. General, but less common in Missouri than the following variety: Daviess, Sullivan, Adair, Saline, Callaway, St. Louis, Washington, Ste. Genevieve, Iron, Scott, Butler, Ozark, Gentry, Clay, Jackson, Benton, Cedar, Greene, Barry, and McDonald counties.

Acer saccharum f. **Rugelii** (Pax) Palmer & Steyermark, comb. nov.

Acer Rugelii Pax.

Acer saccharum var. *Rugelii* (Pax) Rehder.

Occasionally found with the typical form. Circumneutral. Eastern and southern Mo., scattered: St. Louis, Washington, St. Francois, Madison, Iron, Shannon, Wayne, Butler, Texas, and McDonald counties. A leaf form sometimes looking distinct, but inconstant.

Acer saccharum var. **glaucum** (Pax) Sarg. Bot. Gaz. **67**: 233. 1919.

In similar situations to the typical form and more common, especially in the Ozark region. Eastern, central, and southern Mo.

Acer saccharum var. **Schneckii** Rehder in Sarg. Trees & Shrubs **2**: 356. 1913.
Alluvial woods. Circumneutral. Southeastern Mo. and locally in central Mo.: Perry, Cape Girardeau, Bollinger, Madison, Iron, Scott, Mississippi, Stoddard, Dunklin, Wayne, and Benton counties.

Acer floridanum (Chapm.) Pax.
Low woods. Circumneutral to oxylophile. Southeastern Mo.: Wayne and Dunklin counties.

Acer nigrum Marsh. Black Maple.
Upland woods and along small streams. Circumneutral. Northern and central Mo., and occasionally in the southern part of state: Mercer, Grundy, Putnam, Schuyler, Adair, Clark, Knox, Marion, Shelby, Monroe, Randolph, Howard, Boone, Cooper, Moniteau, Montgomery, Warren, St. Louis, Washington, Butler, Taney, Holt, Andrew, Clay, Jackson, and Lafayette counties.

Acer nigrum var. **Palmeri** Sarg. Jour. Arnold Arb. **2**: 166. 1921.
Occasionally found with the typical form: Clark, Lewis, Grundy, and Jackson counties.

Acer saccharinum L. Silver Maple, Soft Maple.
Low wet woods and alluvial banks of streams. Circumneutral. General and probably in every county.

Acer rubrum L. Red Maple.
Low wet woods, and rocky hillsides and bluffs in the Ozark region. Circumneutral. Central and southern Mo., south and east of a line from St. Louis, Warren, Boone, and Morgan counties to McDonald Co.

Acer rubrum var. **Drummondii** (Hook. & Arn.) T. & G.
Low wet woods and swamps. Circumneutral. Southeastern Mo.: Perry, Cape Girardeau, Scott, Mississippi, New Madrid, Stoddard, Dunklin, Butler, and Ripley counties.

Acer rubrum var. **Drummondii** f. **rotundata** Sarg. Bot. Gaz. **67**: 237. 1919.
Rarely found with the preceding form. Southeastern Mo., local: Dunklin and Ripley counties.

Acer rubrum var. **tridens** Wood.
Sometimes found with the typical form. Circumneutral to oxylophile. Eastern Mo., south of the Missouri River: St. Louis, Jefferson, Franklin, Iron, Stoddard, and Dunklin counties.

Acer Negundo L. Box Elder.
Low alluvial woods. Circumneutral. General.

Acer Negundo var. **texanum** Pax.
Woods along streams, and along rocky bluffs. Circumneutral. Southwestern Mo.: Lawrence, Jasper, and McDonald counties.

Acer Negundo var. **interior** (Britton) Sarg. Bot. Gaz. **67**: 239. 1919.
Woods along streams. Circumneutral. Northwestern Mo.: Grundy, Platte, Clay, and Jackson counties.

Acer Negundo var. **violaceum** Kirch.
Alluvial ground along streams. Circumneutral. Northern Mo.: Scotland, Schuyler, Adair, Putnam, Sullivan, Linn, Mercer, Grundy, Livingston, Harrison,

Daviess, Worth, Gentry, Dekalb, Clinton, Lafayette, Nodaway, Atchison, and Buchanan counties.

Fam. SAPINDACEAE

Sapindus Drummondi Hook. & Arn. Soapberry, Wild China Tree.

Glades, and along the base of bluffs with south or west exposures. Calciphile to circumneutral. Southwestern Mo.: Taney, Stone, Barry, Jasper, Newton, and McDonald counties.

CARDIOSPERMUM HALICACABUM L. Balloon Vine.

Infrequently escaped from gardens to roadsides and waste ground. St. Louis Co.

Fam. HIPPOCASTANACEAE

Aesculus glabra Willd. Ohio Buckeye.

Low alluvial woods along streams. Circumneutral. Scattered: Putnam, Marion, Pike, Jackson, Barry, and McDonald counties. The typical form of the species is quite rare in Mo.

Aesculus glabra var. **Sargentii** Rehder, Jour. Arnold Arb. **7**: 241. 1926.

Aesculus glabra var. *arguta* Robinson, in part (G).

Aesculus glabra var. *Buckleyi* Sarg., in part.

Thickets and glades. Circumneutral. General but scattered: Lewis, Marion, Pike, Washington, Perry, Bollinger, St. Clair, Jackson, Cass, Vernon, and Jasper counties. Previously confused with *Aesculus arguta* Buckley, a southwestern species which does not occur in Mo.

Aesculus glabra var. **leucodermis** Sarg. Trees & Shrubs **2**: 262. 1913.

Rocky woods and along small rocky streams. Circumneutral. Southern and east-central Mo.: St. Louis, Maries, Dallas, Webster, Douglas, Ozark, and Taney counties.

Aesculus glabra var. **pallida** (Willd.) Kirchner. See Jour. Arnold Arb. **2**: 118. 1920.

Open woods, thickets, and low or rocky ground along streams. Circumneutral. General. This is the common variety of buckeye found in the state.

Aesculus discolor Pursh. Red-flowered Buckeye.

Aesculus Pavia of auth., not L. (G), in part (B & B).

Low open woods. Circumneutral. Southeastern Mo.: Cape Girardeau and Dunklin counties.

Aesculus discolor var. **mollis** Sarg. Trees & Shrubs **2**: 267. 1913.

Aesculus austrina Small (B & B).

Low open woods and thickets along streams. Southeastern Mo., in the lowlands and locally north to Phelps Co.: Madison, Bollinger, Cape Girardeau, Scott, Stoddard, Dunklin, Butler, Wayne, Ripley, Carter, Oregon, and Phelps counties.

Fam. BALSAMINACEAE

Impatiens pallida Nutt. Pale-flowered Touch-me-not.

Low wet woods, bogs, and springy banks. Circumneutral. General.

Impatiens biflora Walt. Spotted-flowered Touch-me-not.
Similar situations to the last. Circumneutral. General.

IMPATIENS BALSAMINA L.
Cultivated and sometimes escaped. Dunklin Co.

Fam. RHAMNACEAE

Berchemia scandens (Hill) Trelease. Supple-Jack.
Low swampy woods, and ledges and slopes of bald knobs and bluffs with seepage water. Calciphile to circumneutral. Southern Mo.: Mississippi, New Madrid, Pemiscot, Dunklin, Stoddard, Butler, Ripley, Dent, Shannon, Oregon, Texas, Howell, Douglas, Ozark, Taney, Stone, and Barry counties.

Rhamnus lanceolata Pursh.
Glades and thickets. Calciphile. General except in the southeastern lowlands where it is apparently absent.

Rhamnus caroliniana Walt. Indian Cherry.
Rocky open woods, thickets, and glades. Calciphile to circumneutral. Central and southern Mo.: Boone, Moniteau, St. Charles, Osage, Maries, Phelps, Gasconade, Crawford, Franklin, St. Louis, Jefferson, St. Francois, Bollinger, Madison, Iron, Reynolds, Wayne, Dunklin, Ripley, Carter, Oregon, Dent, Shannon, Texas, Howell, Wright, Douglas, Ozark, Taney, Stone, Barry, and Jasper counties.

Rhamnus caroliniana var. **mollis** Fernald, Rh. **12**: 79. 1910.
In similar situations to the preceding. East-central and southern Mo.: St. Charles, St. Louis, Jefferson, Franklin, St. Francois, Bollinger, Iron, Wayne, Reynolds, Carter, Ripley, Oregon, Shannon, Crawford, Gasconade, Ozark, Miller, and Hickory counties.

RHAMNUS CATHARTICA L. Buckthorn.
Thickets and waste ground. Introduced in Marion and Boone counties.

Ceanothus americanus L. New Jersey Tea.
Rocky open woods, thickets, and glades. Circumneutral. General but commonest in southern Mo.

Ceanothus ovatus Desf. Red-root.
Rocky woods and glades. Circumneutral to oxylophile. Scatterred: Iron, Jackson, St. Clair, Jasper, Newton, and McDonald counties.

Ceanothus ovatus var. **pubescens** T. & G.
Rocky prairies, plains, and loess hills. Calciphile to circumneutral. General.

Fam. VITACEAE

Parthenocissus quinquefolia (L.) Planch. Virginia Creeper.
Psedera quinquefolia (L.) Greene (G).
Open woods, thickets, fence rows, and along rocky bluffs. Circumneutral. General and probably in every county.

Parthenocissus quinquefolia var. **hirsuta** (Donn) Planch.
Psedera quinquefolia var. *hirsuta* (Donn) Rehder (G).
Rocky open woods, thickets, and glades. Circumneutral. General but scat-

tered: Adair, Monroe, Ralls, Boone, Iron, Scott, Ripley, Dallas, Pulaski, Atchison, Gentry, Jackson, Johnson, Jasper, and Newton counties.

Parthenocissus quinquefolia var. **Saint-Paulii** (Koehne & Graebn.) Rehder.

Psedera quinquefolia var. *Saint-Paulii* (Koehne & Graebn.) Rehder (G).

Rocky open woods, thickets, and bluffs. Circumneutral. Southern and western Mo.: Mississippi, Ripley, Pulaski, Stone, Jackson, Cedar, Jasper, Newton, and McDonald counties.

Parthenocissus vitacea (Knerr) Hitchc.

Psedera vitacea (Knerr) Greene (G).

Thickets, open woods, and along bluffs and fence rows. Circumneutral. General but scattered: Clark, Atchison, Holt, Jackson, Cooper, Christian, Stone, Jasper, and Newton counties.

Ampelopsis cordata Michx. Raccoon Grape, False Grape.

Cissus Ampelopsis Pers. (G).

Open woods, thickets, and fence rows. Circumneutral. General.

Ampelopsis arborea (L.) Rusby. Pepper-vine.

Cissus arborea (L.) Des Moulins (G).

Low open woods and thickets. Circumneutral. Eastern Mo., south of the Missouri River: St. Louis, Jefferson, St. Francois, Perry, Cape Girardeau, Mississippi, New Madrid, Pemiscot, Dunklin, and Butler counties.

Cissus incisa (Nutt.) Des Moulins.

Rocky ledges of bluffs with south or west exposure. Calciphile. Southwestern Mo.: Taney and McDonald counties.

Vitis labrusca L. Northern Fox Grape.

Cultivated and occasionally escaped into thickets and waste ground. Scattered: St. Louis and Jasper counties.

Vitis aestivalis Michx. Summer Grape.

Upland woods and thickets. Circumneutral to oxylophile. General.

Vitis Lincecumii Buckley var. **glauca** Munson. See Bailey, Gent. Herb. **3**: 193. 1934. Post Oak Grape.

Rocky upland woods, glades, and thickets. Circumneutral to oxylophile. Central and southern Mo., mostly in the Ozark region: Boone, St. Louis, Scott, Stoddard, Dunklin, Wayne, Iron, Reynolds, Shannon, Howell, Texas, Phelps, Maries, Laclede, Dallas, Douglas, Taney, Stone, Barry, Polk, Hickory, Jackson, Cedar, Barry, Vernon, Jasper, Newton, and McDonald counties. This has sometimes been confused with *Vitis Lecontiana*, or *V. bicolor* as it was formerly called.

Vitis cinerea Engelm. Winter Grape, Bird Grape.

Low alluvial woods, thickets, and fence rows. Circumneutral. General and common.

Vitis cinerea var. **canescens** (Engelm.) Bailey.

Occasionally found with the typical form. Scattered: St. Louis, Boone, and Jasper counties.

Vitis cordifolia Michx. Frost Grape.

Alluvial woods and thickets along streams. Circumneutral. General and common.

Vitis cordifolia var. **foetida** Engelm.
Growing with the typical form. Local: St. Louis Co.

Vitis vulpina L. River-bank Grape.
Alluvial woods, thickets, and banks of streams. Circumneutral. Northern and central Mo., and locally south to Madison Co.: Pike, St. Charles, St. Louis, Madison, Montgomery, Scotland, Knox, Shelby, Monroe, Audrain, Callaway, Boone, Warren, Cooper, Morgan, Pettis, Schuyler, Adair, Putnam, Sullivan, Linn, Mercer, Grundy, Livingston, Carroll, Harrison, Daviess, Caldwell, Worth, Gentry, Dekalb, Clinton, Atchison, Nodaway, Holt, Andrew, Buchanan, Platte, Jackson, Bates, and Vernon counties.

Vitis vulpina var. **praecox** Bailey.
In similar situations to the typical form. Circumneutral. Central Mo.: St. Louis, St. Charles, Boone, Carroll, Clay, and Jackson counties.

Vitis palmata Vahl. Red Grape.
Low wet woods and borders of swamps and bayous. Circumneutral. East-central and southeastern Mo.: St. Charles, St. Louis, Jefferson, Bollinger, New Madrid, Pemiscot, Dunklin, and Butler counties.

Vitis rupestris Scheele. Sand Grape.
Rocky banks and beds of streams. Circumneutral to oxylophile. Central and southern Mo.: Montgomery, Franklin, Jefferson, Washington, Madison, Iron, Reynolds, Carter, Oregon, Shannon, Howell, Texas, Phelps, Pulaski, Laclede, Dallas, Miller, Morgan, Stone, Barry, Jasper, Newton, and McDonald counties.

Vitis rupestris var. **dissecta** Eggert.
Rocky ground along streams. Oxylophile. Eastern Mo., south of the Missouri River: St. Louis, Jefferson, and Carter counties.

Vitis rotundifolia Michx. Muscadine.
Low open woods and borders of swamps and bayous. Oxylophile. Southeastern Mo.: Madison, Pemiscot, and Dunklin counties.

Fam. Tiliaceae

Tilia glabra Vent. See Bot. Gaz. **66**: 424. 1918. Linn, Linden.
Tilia americana of auth., and perhaps L., in part (G), (B & B).
Woods and bluffs along streams. Circumneutral. General, but apparently absent from some of the southern and western counties.

Tilia floridana Ashe.
Bluffs and rocky woods along streams. Circumneutral. Southern Mo. and along the larger streams to the northern boundary: Clark, Ralls, St. Louis, Ste. Genevieve, Madison, Iron, Wayne, Butler, Carter, Shannon, Douglas, Ozark, Taney, Greene, Stone, Barry, Holt, Jackson, Dade, Newton, and McDonald counties.

Tilia floridana var. **hypoleuca** Sarg. Bot. Gaz. **66**: 436. 1918.
Rocky woods and bluffs. Circumneutral. Southern Mo.: Ozark, Taney, Stone, and Barry counties. Sometimes looks very distinct, but intergrades with the typical form.

Tilia heterophylla Vent. var. **Michauxii** (Nutt.) Sarg. Bot. Gaz. **66**: 506. 1918.
Tilia Michauxii Nutt. (G), (B & B).

Rocky woods and bluffs. Circumneutral. Eastern Mo.: Marion, St. Francois, and Butler counties.

Fam. MALVACEAE

ABUTILON THEOPHRASTI Medic. Velvet Leaf.

Cultivated fields and waste ground. Indifferent. General.

Malvastrum angustum Gray. Yellow False Mallow.

Rocky prairies and glades. Calciphile to circumneutral. Central, southern, and western Mo.: Montgomery, Lincoln, St. Louis, Jefferson, Franklin, Washington, Shannon, Ozark, Taney, Stone, Greene, Polk, Daviess, Jackson, Cass, Henry, St. Clair, and Jasper counties.

Sida Elliottii T. & G.

Sandy open ground. Oxylophile. Southeastern Mo.: Scott, Stoddard, and Dunklin counties.

SIDA SPINOSA L.

Cultivated and waste ground. Circumneutral. General.

ANODA CRISTATA Schlecht. var. BRACHYANTHA (Reichb.) Hochr. Ann. Conserv. & Jard. Bot. Genève **20**: 47. 1916.

Introduced in waste ground. McDonald Co.

ALTHAEA ROSEA (L.) Cav. Hollyhock.

Cultivated in gardens and sometimes escaping to roadsides, fields, and waste ground. Boone, Saline, and Greene counties.

MALVA ROTUNDIFOLIA L. Common Mallow, Cheeses.

Fields, lawns, and waste ground. Indifferent. General.

MALVA PARVIFLORA L.

Fields and waste ground. Indifferent. Scattered: Atchison and Jackson counties.

MALVA MOSCHATA L. Musk Mallow.

Fields and waste ground. Indifferent. Scattered: Boone Co.

MALVA SYLVESTRIS L. High Mallow.

Roadsides and waste ground. Indifferent. Scattered: Warren, Jackson, Greene, and Stone counties.

MALVA CRISPA L. Curled Mallow.

Waste ground. Indifferent. Scattered: Osage and Jackson counties, and also reported from Greene Co.

Callirhoë triangulata (Leavenworth) Gray. Clustered Poppy Mallow.

Rocky open woods, prairies, and glades. Circumneutral. East-central and southeastern Mo.: St. Louis, Franklin, Scott, and Mississippi counties.

Callirhoë involucrata (T. & G.) Gray. Wine Cups, Purple Poppy Mallow.

Upland prairies, fields, and roadsides. Circumneutral to oxylophile. Scattered: Putnam, St. Louis, Linn, Boone, Jackson, and Taney counties.

Callirhoë Papaver (Cav.) Gray.

Rocky prairies and glades. Calciphile to circumneutral. Scattered: Pulaski, Pettis, Jackson, and Barry counties.

Callirhoë Bushii Fernald, Rh. **11**: 51. 1909.
Rocky open woods and glades. Calciphile. Southwestern Mo.: Taney and Barry counties.

Callirhoë digitata Nutt. Fringed Poppy Mallow.
Rocky prairies, meadows, and glades. Circumneutral to oxylophile. Central and southwestern Mo.: Boone, Clay, Polk, Greene, Christian, Taney, Stone, Dade, Lawrence, Barry, Barton, Jasper, Newton, and McDonald counties. Perhaps introduced in central Mo.

Callirhoë alcaeoides (Michx.) Gray. Poppy Mallow.
Prairies, open woods, and waste ground. Circumneutral. Scattered: Shelby, Boone, St. Louis, Dent, Clay, Jackson, Greene, and Jasper counties.

Hibiscus lasiocarpos Cav.
Low open woods, and borders of sloughs, ponds, and bayous. Circumneutral. Central and southern Mo.: Platte, Lincoln, St. Charles, St. Louis, Jefferson, Franklin, Cape Girardeau, Perry, Scott, Mississippi, New Madrid, Pemiscot, Dunklin, Butler, Ripley, Wayne, Dent, Shannon, Pulaski, Oregon, Howell, Gasconade, Jasper, and Newton counties. This has sometimes been confused with *Hibiscus incanus* which is not known to occur in Mo.

Hibiscus militaris Cav.
Prairie sloughs, and borders of ponds and slow streams. Circumneutral. General.

HIBISCUS TRIONUM L. Flower-of-an-hour.
Fields, roadsides, waste and cultivated ground. Indifferent. General, but commonest in northern and central Mo.

HIBISCUS SYRIACUS L. Rose of Sharon, Shrubby Althea.
Commonly planted and rarely escaped to thickets and roadsides. Jasper Co.

Fam. HYPERICACEAE

Ascyrum hypericoides L. St. Andrew's Cross.
Rocky open woods. Oxylophile to circumneutral. East-central and southern Mo., mainly in the Ozark region.

Hypericum Ascyron L. Great St. John's wort.
Moist open woods and thickets. Oxylophile to circumneutral. Northern and central Mo., scattered: Clark, Atchison, and Jackson counties.

HYPERICUM PERFORATUM L. St. John's-wort.
Rocky pastures and waste ground. Circumneutral to oxylophile. General but scattered: Mercer, Clark, Shelby, Marion, Ralls, Boone, St. Louis, Jefferson, Franklin, Dunklin, Dent, Shannon, Texas, Laclede, Clay, Jackson, and Greene counties.

Hypericum punctatum Lam.
Moist open woods, thickets, and prairie swales. Circumneutral. General.

Hypericum pseudomaculatum Bush.
Rocky prairies and glades. Oxylophile to circumneutral. Southern Mo.: Phelps, Shannon, Ozark, Barry, Jasper, Newton, and McDonald counties.

Hypericum densiflorum Pursh.

Sandy open ground and glades. Oxylophile. Southeastern Mo., scattered: Madison and Ripley counties.

Hypericum prolificum L. Shrubby St. John's-wort.

Rocky ground along streams and bluffs. Circumneutral to oxylophile. Eastern, middle, and southern Mo., and occasional in the western counties.

Hypericum cistifolium Lam.

Rocky prairies, open woods, and glades. Oxylophile to circumneutral. General.

Hypericum mutilum L. Dwarf St. John's-wort.

Open woods, prairie swales, and borders of ponds and ditches. Circumneutral. Eastern, central, and southern Mo.

Hypericum gymnanthum Engelm. & Gray.

Moist, sandy, open ground. Oxylophile. Southern Mo., scattered: Mississippi, Shannon, Greene, and McDonald counties.

Hypericum gentianoides (L.) BSP. Pine-weed.

Sterile open ground, prairies, and glades. Oxylophile, usually on siliceous or granitic rocks. East-central and southern Mo.: Warren, Lincoln, St. Charles, Jefferson, Franklin, Washington, St. Francois, Ste. Genevieve, Perry, Madison, Iron, Dunklin, Ripley, Reynolds, Shannon, Texas, Dent, Crawford, Gasconade, Maries, Pulaski, Greene, Stone, Cedar, Dade, Barton, Jasper, and McDonald counties.

Hypericum Drummondii (Grev. & Hook.) T. & G.

Fields, prairie swales, barrens, and open woods. Oxylophile. Eastern, central, and southern Mo.: Knox, Marion, Randolph, Boone, Montgomery, Lincoln, St. Charles, St. Louis, Jefferson, St. Francois, Ste. Genevieve, Perry, Madison, Iron, Wayne, Stoddard, Dunklin, Butler, Franklin, Gasconade, Crawford, Maries, Phelps, Dent, Shannon, Texas, Howell, Ozark, Polk, Greene, St. Clair, Dade, Barry, Vernon, Barton, Jasper, Newton, and McDonald counties.

Hypericum lobocarpum Gattinger.

Sandy open ground. Oxylophile. Southeastern Mo.: Dunklin Co.

Hypericum petiolatum Walt.

Low wet woods, swamps, bayous, and wet ledges along sandstone bluffs. Oxylophile to circumneutral. Southeastern Mo.: Ste. Genevieve, Bollinger, Mississippi, New Madrid, Dunklin, Butler, and Ripley counties.

Hypericum virginicum L.

Low wet woods, swamps, and bayous. Circumneutral. Southeastern Mo.: Dunklin and Butler counties.

Fam. ELATINACEAE

Elatine americana (Pursh) Arn. See Rh. **19**: 12. 1917. Waterwort.

Ditches and borders of sloughs and swales. Circumneutral. Western Mo., local: Jackson Co.

Bergia texana (Hook.) Seub.

Sand bars of the Missouri River. Oxylophile to circumneutral. Western Mo., local: Jackson Co.

Fam. Tamaricaceae

Tamarix gallica L. Tamarisk.

Recently introduced along sand bars and banks of the Missouri and Mississippi Rivers. Oxylophile to circumneutral. Northwestern and central Mo.: St. Louis, Warren, Carroll, Jackson, and Holt counties.

Fam. Cistaceae

Helianthemum Bicknellii Fernald, Rh. **21**: 36. 1919. Rock Rose.

Helianthemum majus Bicknell, not BSP. (G).

Crocanthemum majus (L.) Britton (B & B).

Rocky prairies and dry open woods. Oxylophile. General: St. Louis, Jefferson, Dent, Shannon, Crawford, Oregon, Texas, Howell, Shelby, Putnam, Sullivan, Linn, Boone, Mercer, Jackson, Greene, Barry, Jasper, and McDonald counties. This has been confused with *Helianthemum canadense* which is not known to occur in Mo.

Lechea villosa Ell. Pinweed.

Lechea major Michx., not L. (B & B).

Rocky open woods and glades. Oxylophile. Eastern, central, and southern Mo.: Knox, Shelby, Boone, Lincoln, Warren, St. Charles, St. Louis, Jefferson, Perry, Iron, Madison, Bollinger, Mississippi, Dunklin, Butler, Ripley, Oregon, Howell, Carter, Shannon, Texas, Reynolds, Dent, Crawford, Phelps, Camden, Polk, Greene, Taney, Barry, Jackson, Vernon, Jasper, Newton, and McDonald counties.

Lechea tenuifolia Michx. Pinweed.

Rocky open woods and glades. Oxylophile. General, except in the Southeastern lowlands.

Fam. Violaceae

Hybanthus concolor (Forster) Spreng. Green Violet.

Rich woods and along shaded bluffs. Circumneutral to calciphile. General.

Viola pedata L. Bird-foot Violet, Wild Pansy.

Rocky open woods and prairies. Oxylophile. General, but commonest in east-central and southern Mo.

Viola pedata L. var. **lineariloba** DC.

In similar situations to the typical form and much commoner in most parts of the state.

Viola missouriensis Greene.

Low woods, thickets, and moist alluvial ground along streams. Circumneutral. General but scattered: Clark, Adair, Howard, Boone, Audrain, St. Charles, Gasconade, Franklin, St. Louis, Jefferson, Ste. Genevieve, Mississippi, Dunklin, Butler, Wayne, Madison, Ripley, Carter, Moniteau, Dallas, Hickory, Polk, Howell, Greene, Stone, Linn, Grundy, Daviess, Livingston, Platte, Clay, Jackson, Henry, Bates, Jasper, and Newton counties.

Viola papilionacea Pursh. See Bull. Vt. Agr. Exp. Sta. 224: 22. 1921.

Viola pratincola Greene.

Moist meadows, thickets, open woods, and waste or alluvial ground. Circum-

neutral. General. This species has often been confused with *Viola cucullata* which is not known in Missouri.

Viola triloba Schwein.

Rocky or dry open woods and thickets. Oxylophile to circumneutral. Central and southern Mo. north to St. Louis, Warren, Boone, and Jackson counties. This species and the following variety have often been confused with *Viola palmata* which is not known to occur in Missouri.

Viola triloba var. **dilatata** (Ell.) Brainerd, Bull. Torr. Bot. Club **37**: 587. 1910.

Similar situations to the preceding and often found with it. Oxylophile to circumneutral. Central and southern Mo. south and east of a line drawn from St. Louis, Warren, Boone, Moniteau, and Polk counties to Jasper Co., and locally northwest in Atchison Co., northwestern Mo.

Viola Lovelliana Brainerd, Bull. Torr. Bot. Club **37**: 526. 1910.

Moist rocky ground. Circumneutral. Southern Mo., local: Ozark Co.

Viola sororia Willd.

Open woods, rocky or dry slopes, and thickets. Oxylophile to circumneutral. General.

Viola sagittata Ait.

Upland prairies, open banks, and glades. Oxylophile to circumneutral. General, but scattered: Putnam, Schuyler, Adair, Macon, Scotland, Knox, Shelby, Monroe, Audrain, Marion, Ralls, Pike, Randolph, Boone, Callaway, Franklin, Crawford, Washington, Iron, Madison, Carter, Phelps, Moniteau, Greene, Henry, Vernon, Barton, Jasper, Newton, Barry, and McDonald counties. A pubescent form of this species *(V. subsagittata* Greene) has sometimes been confused with *Viola fimbriatula* which is not known in Missouri.

Viola emarginata (Nutt.) LeConte.

Prairies, glades, and open banks. Oxylophile to circumneutral. East-central and southern Mo.: St. Louis, Madison, Iron, Reynolds, Shannon, Oregon, Moniteau, Jasper, Newton, and McDonald counties.

Viola pedatifida G. Don. Prairie Violet.

Prairies, borders of woods, and loess hills. Circumneutral. Northern, central, and western Mo.: Putnam, Schuyler, Scotland, Adair, Knox, St. Louis, Daviess, Atchison, Pettis, Cedar, Greene, Barry, Jackson, Cass, and Jasper counties.

Viola viarum Pollard.

Moist woods, banks of streams, open ground along roads, and crevices of rocks along streams. Circumneutral. General but scattered: Schuyler, Sullivan, St. Louis, St. Francois, Crawford, Shannon, Oregon, Ozark, Pulaski, Laclede, Texas, Saline, Daviess, Worth, Atchison, Jackson, Henry, Hickory, Stone, Barry, and Jasper counties.

Viola lanceolata L. Narrow-leaved Violet.

Moist sandy prairies, swampy open ground, and moist hummocks. Oxylophile. Southeastern Mo.: Mississippi and Dent counties.

Viola pallens (Banks) Brainerd. Northern White Violet.

Banks of streams and moist ledges along bluffs of LaMotte sandstone. Oxylophile. Southeastern Mo., local: Ste. Genevieve Co.

Viola pubescens Ait. Yellow Violet.

Rich woods and thickets. Circumneutral. Northern and eastern Mo.: Harrison, Mercer, Putnam, Sullivan, Schuyler, Shelby, Ralls, St. Louis, St. Francois, Stoddard, and Butler counties. This has frequently been confused with the next following.

Viola eriocarpa Schwein. See Rh. **23**: 275. 1922; also Bull. Torr. Bot. Club **38**: 194. 1911.

Viola scabriuscula Schwein., in part (G), (B & B).

Rich, alluvial or rocky woods. Circumneutral. General.

Viola eriocarpa var. **leiocarpa** Fernald & Wiegand, Rh. **23**: 275. 1922.

Viola scabriuscula Schwein., in part (G), (B & B).

Rich, alluvial or rocky woods. Circumneutral. General and commoner than the species.

Viola striata Ait. Pale Violet.

Moist rich or rocky woods, and alluvial ground along streams. Circumneutral. Eastern, middle, and southern Mo. south and east of a line drawn from Shelby, Randolph, Boone, and Hickory counties to Barry Co.

Viola Rafinesquii Greene. Wild Pansy, Johnny Jump-up.

Prairies, glades, roadsides, and waste ground. Indifferent. General and common.

VIOLA ARVENSIS Murr.

Fields, roadsides, and waste ground. Indifferent. Introduced in Johnson Co.

Viola papilionacea × **pedatifida** Brainerd, Bull. Torr. Bot. Club **40**: 249, *pl. 15.* 1913.

Prairies and thickets. Western Mo., scattered: Jackson, Pettis, and Jasper counties.

Viola papilionacea × **triloba** Brainerd, Bull. Torr. Bot. Club **39**: 90. 1912.

Woods, thickets, and open banks. Jasper Co.

Viola pedatifida × **sagittata** Brainerd, Bull. Torr. Bot. Club **40**: 252, *pl. 16.* 1913.

Prairies. Jasper Co.

Viola pedatifida × **sororia** Brainerd, Bull. Torr. Bot. Club **40**: 253, *pl. 17.* 1913.

Loess hills. Atchison Co.

Viola sororia × **triloba** Brainerd, Bull. Torr. Bot. Club **39**: 92. 1912.

Open woods and thickets. Southern Mo., scattered: Oregon, Greene, and Jasper counties.

Viola emarginata × **sororia** Dowell, Proc. Staten Isl. Assoc. **3**: 162. 1912.

Prairies, thickets, and open banks. Jasper Co.

Viola sagittata × **sororia** Brainerd, Bull. Vt. Agr. Exp. Sta. 239: 193. 1924.

Thickets and open banks. Jasper Co.

Viola papilionacea × **sororia** Brainerd, Bull. Torr. Bot. Club **37**: 178. 1910.

Moist woods, thickets, and open ground along roads and banks. Commonly found throughout the state where the parent species occur.

Viola missouriensis × **sororia.**

Low open ground and banks. Sometimes occurring with the parent species.

Fam. PASSIFLORACEAE

Passiflora lutea L.

Thickets and low or open rocky woods. Circumneutral. East-central and southern Mo. south and east of a line drawn from St. Charles, Warren, Montgomery, Morgan, Hickory, and Cedar counties to Jasper Co.

Passiflora incarnata L. Maypops, Passion Flower.

Fields, thickets, low alluvial woods, and along railroads and roadsides. Circumneutral to oxylophile. Southern Mo.: Scott, Mississippi, New Madrid, Stoddard, Pemiscot, Dunklin, Butler, Oregon, Greene, Lawrence, Barry, Jasper, and McDonald counties. Probably native in southeastern Mo. and introduced in some of the southwestern counties.

Fam. LOASACEAE

Mentzelia oligosperma Nutt. Stick Leaf.

Exposed ledges along bluffs, glades, rocky open soil, and railway embankments. Calciphile to circumneutral. Central and southern Mo.: St. Charles, St. Louis, Phelps, Pulaski, Boone, Saline, Jackson, Henry, Greene, Jasper, and McDonald counties.

Fam. CACTACEAE

Opuntia Rafinesquii Engelm. Prickly Pear.

Rocky prairies, glades, and open woods. Circumneutral to calciphile. Southern and central Mo. south of a line drawn from Ralls, Monroe, Boone, and Saline counties to Caldwell Co.

Opuntia macrorhiza Engelm.

Rocky ledges and glades. Oxylophile. Southwestern Mo.: Jasper, Newton, McDonald, and Barry counties.

Mamillaria missouriensis Sweet var. **caespitosa** (Engelm.) Wats. Nipple Cactus.

Rocky bluffs. Circumneutral to calciphile. Found in Pulaski Co., where perhaps native.

Fam. THYMELAEACEAE

Dirca palustris L. Leatherwood.

Shaded rocky bluffs, banks of streams, and low alluvial woods. Oxylophile to circumneutral. Central and southern Mo., and locally in extreme northern Mo.: Mercer, Callaway, Warren, Perry, Bollinger, Wayne, Madison, Iron, Reynolds, Shannon, Oregon, Washington, Crawford, Phelps, Maries, Osage, Morgan, Benton, Laclede, Texas, Taney, Stone, and Barry counties.

Fam. ELAEAGNACEAE

ELAEAGNUS ANGUSTIFOLIA L. Russian Olive.

Cultivated and rarely escaped to thickets and waste ground. Pike and St. Louis counties.

Fam. LYTHRACEAE

Peplis diandra Nutt. Water Purslane.

Didiplis diandra (Nutt.) Wood (G), (B & B).

Borders of ponds, sloughs, and ditches. Circumneutral. General but scattered: Livingston, Sullivan, Shelby, Audrain, St. Charles, St. Louis, Jefferson, Butler, Carter, Oregon, Greene, Clay, Jackson, and Jasper counties.

Rotala ramosior (L.) Koehne var. **interior** Fernald & Griscom, Rh. **37**: 169. 1935. Tooth-cup.

Rotala ramosior of auth. (G), (B & B), in part.

Wet prairies, ditches, sloughs, and margins of ponds and streams. Circumneutral. Central and southern Mo.: Randolph, Boone, Lincoln, St. Charles, Gasconade, St. Louis, Jefferson, Perry, Wayne, New Madrid, Butler, Dunklin, Iron, Madison, Dent, Laclede, Howell, Ozark, Taney, Cedar, Greene, Jackson, Barton, Jasper, Newton, and McDonald counties.

Ammannia coccinea Rottb. Tooth-cup.

Ditches, sloughs, and muddy margins of ponds and slow streams. Circumneutral. General.

Ammannia auriculata Willd.

Similar situations to the preceding. Circumneutral. Western Mo., south of the Missouri River: Jackson, Taney, Jasper, and McDonald counties.

Lythrum alatum Pursh. Winged Loosestrife.

Wet prairies and alluvial margins of small streams and ponds. Circumneutral. General.

LYTHRUM SALICARIA L. Purple Loosestrife.

Introduced in waste ground. Franklin Co.

Cuphea petiolata (L.) Koehne.

Open woods, thickets, prairies, and glades. Circumneutral. General.

Fam. MELASTOMACEAE

Rhexia mariana L. var. **leiosperma** Fernald & Griscom, Rh. **37**: 171. 1935. Meadow Beauty.

Moist sandy open ground, and borders of bogs. Oxylophile. Southeastern Mo.: Mississippi, Stoddard, Dunklin, Butler, and Ripley counties.

Rhexia virginica L. Deer-grass, Meadow Beauty.

Moist open ground and borders of bogs. Oxylophile. Southeastern Mo.: St. Francois, Iron, Dunklin, Butler, and Dent counties.

Rhexia interior Pennell.

Rhexia latifolia Bush, not Aubl. See Rh. **13**: 167. 1911.

Rhexia virginica of auth., not L. (B & B), in part.

Moist sandy soil along prairie streams. Oxylophile. Southwestern Mo.: Greene, Lawrence, Vernon, Barton, and Jasper counties.

Fam. ONAGRACEAE

Jussiaea decurrens (Walt.) DC. Primrose-willow.

Swamps, bayous, and still streams. Circumneutral. Southern Mo.: Wayne, Scott, Mississippi, New Madrid, Pemiscot, Dunklin, Butler, and Barry counties.

Jussiaea diffusa Forsk. Floating Primrose-willow.

Sloughs, ponds, and slow streams; in shallow water or on mud. Circumneutral. General.

Ludvigia alternifolia L. Seed-box.

Prairie swales, low open woods, and borders of streams. Circumneutral. General.

Ludvigia polycarpa Short & Peter. False Loosestrife.

Wet open woods and along prairie streams and sloughs. Circumneutral. General but scattered: Putnam, Clark, Shelby, Dekalb, Randolph, Boone, St. Louis, Jefferson, Iron, Ripley, Ray, Jackson, and Jasper counties.

Ludvigia palustris (L.) Ell. var. **americana** (DC.) Fernald & Griscom, Rh. **37**: 176. 1935.

Ludvigia palustris of auth. in part (G), (B & B).

Low wet woods, and borders of slow streams, ponds, and ditches. Circumneutral. General.

Ludvigia natans Ell. var. **typica** Fernald & Griscom, Rh. **37**: 175. 1935.

Border of pond. Southwestern Mo., local: Greene Co.

Ludvigia glandulosa Walt.

Low wet woods, swamps, and bayous. Circumneutral to oxylophile. Southeastern Mo.: Bollinger, Stoddard, New Madrid, Pemiscot, Dunklin, Butler, and Ripley counties.

Epilobium coloratum Muhl. Willow Herb.

Bogs and wet ground along small streams. Circumneutral. General but scattered: Putnam, Boone, St. Louis, Jefferson, Franklin, Ste. Genevieve, Washington, Iron, Shannon, Dent, Phelps, Greene, Taney, Stone, Barry, Jackson, Newton, and McDonald counties.

Epilobium densum Raf.

Bogs and wet ground along streams. Circumneutral. Local: Jackson Co.

Oenothera rhombipetala Nutt. Evening Primrose.

Sandy open ground. Oxylophile. Eastern and central Mo., scattered: Clark, Ralls, St. Louis, Phelps, and Jackson counties.

Oenothera parviflora L. See Rh. **26**: 4. 1924.

Oenothera muricata L. (G), (B & B).

Open woods, thickets, prairies, and waste ground. Circumneutral. General and common.

Oenothera strigosa (Rydb.) Mack. & Bush.

Oenothera muricata var. *canescens* (T. & G.) Robinson (G).

Fields, prairies, and waste ground. Circumneutral. General: Putnam, Adair, Jefferson, Phelps, Scotland, Worth, Gentry, Dekalb, Grundy, Randolph, Jackson, Henry, and Jasper counties.

Oenothera laciniata Hill.

Fields, prairies, roadsides, and waste ground. Circumneutral. General.

Oenothera laciniata var. **grandiflora** (Wats.) Robinson.

Occasionally found with the typical form. Scattered: Jackson and Jasper counties.

Oenothera linifolia Nutt. Sundrops.

Fields, prairies, and glades. Oxylophile. Central and southern Mo.: Lincoln, Montgomery, Warren, St. Charles, St. Louis, Jefferson, Franklin, Washington,

Crawford, St. Francois, Ste. Genevieve, Perry, Madison, Bollinger, Iron, Wayne, Dunklin, Ripley, Carter, Reynolds, Shannon, Texas, Dent, Oregon, Gasconade, Maries, Phelps, Pulaski, Laclede, St. Clair, Greene, Lawrence, Jackson, Vernon, Barton, Jasper, and Newton counties.

Oenothera fruticosa L. See Rh. **20**: 51. 1918. Sundrops.

Oenothera linearis Michx. (G).

Kneiffia linearis (Michx.) Spach (B & B).

Rocky and sandy open ground. Oxylophile. Southern Mo., scattered: Jefferson, Shannon, and Barry counties.

Oenothera hybrida Michx. See Rh. **24**: 177. 1922.

Oenothera fruticosa var. *hirsuta* Nutt. (G).

Rocky and sandy open ground. Oxylophile. Western Mo., local: Henry Co.

Oenothera pratensis (Small) Robinson.

Kneiffia pratensis Small (B & B).

Moist alluvial ground. Circumneutral. Eastern and southern Mo.: Marion, St. Louis, Jefferson, Wayne, Phelps, and Howell counties.

Oenothera speciosa Nutt. White Evening Primrose.

Hartmannia speciosa (Nutt.) Small (B & B).

Limestone glades and prairies. Calciphile. General but scattered: Adair, Boone, St. Louis, Crawford, Dent, Wayne, Butler, Wright, Greene, Jackson, Johnson, Henry, St. Clair, Vernon, Jasper, and Newton counties.

Oenothera triloba Nutt.

Lavauxia triloba (Nutt.) Spach (B & B).

Limestone glades and prairies. Calciphile. Southern Mo., scattered: Iron and McDonald counties, and also introduced in Benton and Jasper counties.

Oenothera missourensis Sims. Glade Lily, Missouri Primrose.

Megapterium missouriense (Sims) Spach (B & B).

Glades, bald knobs, and rocky prairies. Calciphile. Central and southern Mo.: St. Louis, Jefferson, Franklin, Washington, Crawford, Ste. Genevieve, Stoddard, Shannon, Texas, Phelps, Maries, Pulaski, Miller, Laclede, Camden, Dallas, Cedar, Wright, Webster, Greene, Douglas, Ozark, Taney, Stone, Bates, Lawrence, and Barry counties. The specific name was originally spelled *missourensis* by the author.

Oenothera serrulata Nutt.

Meriolix serrulata (Nutt.) Walp. (B & B).

Loess hills, fields, and prairies. Circumneutral to calciphile. Northern and central Mo.: Marion, St. Louis, Boone, Atchison, Holt, and Jackson counties.

Oenothera biennis L.

Fields, thickets, and waste ground. Circumneutral. General and common.

Gaura biennis L.

Rocky prairies, thickets, and glades. Circumneutral. General.

Gaura filipes Spach.

Rocky open woods. Circumneutral. Southern Mo., local: Phelps Co.

Gaura parviflora Dougl.

Prairies, waste ground, and along railroads and roadsides. Circumneutral. Northern, central, and western Mo., scattered: Shelby, Marion, St. Louis, Boone,

Atchison, Holt, Andrew, Platte, Clay, Jackson, Carroll, and Jasper counties. Introduced from farther west except perhaps in northwestern Mo.

Gaura parviflora var. **lachnocarpa** Weatherby, Rh. **27**: 14. 1925.

Occasionally found with the typical form. Jackson and Jasper counties.

Gaura coccinea Pursh.

Plains and loess hills. Calciphile. Northwestern Mo.: Atchison and Holt counties, and also introduced along railroads in Clay and Jackson counties.

Stenosiphon linifolius (Nutt.) Britton.

Bald knobs and glades. Calciphile. Southern Mo.: Ozark and Taney counties.

Circaea latifolia Hill. See Rh. **19**: 87. 1917. Enchanter's Nightshade.

Circaea lutetiana of Am. auth., not L. (G), (B & B).

Rich woods and thickets. Circumneutral. General.

Fam. HALORAGIDACEAE

MYRIOPHYLLUM PROSERPINACOIDES Gill. Water Feather.

Shallow water and muddy margins of ponds. Circumneutral. Scattered: Crawford, Texas, and Jasper counties. A Chilean species often cultivated in aquaria and pools.

Myriophyllum scabratum Michx.

Slow streams, sloughs, ponds, and ditches. Circumneutral. General but scattered: Scotland, Monroe, Pike, St. Charles, St. Louis, Butler, Carter, Howell, Jackson, and Jasper counties.

Myriophyllum heterophyllum Michx. Water Milfoil.

Slow streams, sloughs, ponds, and spring branches. Circumneutral. East-central and southern Mo.: St. Charles, St. Louis, Jefferson, Perry, Wayne, Dunklin, Butler, Ripley, Carter, Oregon, Crawford, Phelps, Pulaski, Texas, Howell, Ozark, Laclede, Dallas, Greene, and Jasper counties.

Proserpinaca palustris L. See Rh. **37**: 177. 1935.

Ponds, sloughs, and slow streams. Circumneutral. Southeastern Mo.: New Madrid, Dunklin, and Butler counties.

Proserpinaca palustris var. **amblyogona** Fernald, Rh. **11**: 120. 1909.

In similar situations to the typical form. Circumneutral. Southeastern Mo.: Butler and Dunklin counties.

Proserpinaca palustris var. **crebra** Fernald & Griscom, Rh. **37**: 177. 1935.

Swampy woods, ponds, and sloughs. Circumneutral. Scattered: Livingston, St. Louis, Jefferson, Shannon, Barton, and Jasper counties. This is the commonest variety in Missouri.

Fam. ARALIACEAE

Aralia spinosa L. Tear Blanket, Hercules' Club.

Low woods and thickets. Circumneutral. Southeastern Mo.: Cape Girardeau, Bollinger, Madison, Wayne, Stoddard, Dunklin, Butler, and Ripley counties, and also introduced in St. Louis Co.

Aralia racemosa L. American Spikenard.

Rich wooded hillsides, and along shaded bluffs. Circumneutral to oxylophile. Eastern and middle Mo.: Sullivan, Schuyler, Clark, Lewis, Marion, Ralls, Boone, Callaway, Montgomery, Lincoln, Warren, St. Charles, St. Louis, Jefferson, Franklin, Ste. Genevieve, Perry, Bollinger, Stoddard, Scott, Wayne, Reynolds, Shannon, Carter, Oregon, Howell, Texas, Dent, Phelps, Morgan, Benton, Laclede, Douglas, and Ozark counties.

Panax quinquefolium L. Ginseng.

Rich woods and along the base of rocky bluffs. Circumneutral. General but uncommon and being exterminated in many sections through persistent digging by natives: Clark, Pike, Boone, St. Louis, Jefferson, Franklin, Bollinger, Shannon, Jackson, and Greene counties.

Fam. Umbelliferae

Eryngium yuccifolium Michx. Button Snakeroot, Rattlesnake Master.

Rocky open woods, prairies, and glades. Circumneutral. General.

Eryngium prostratum Nutt.

Low wet woods, sandy prairies, and borders of swamps and ponds. Circumneutral to oxylophile. Southeastern Mo.: Scott, Mississippi, Stoddard, Dunklin, Butler, Ripley, Shannon, Texas, and Howell counties.

Sanicula gregaria Bicknell. Black Snakeroot.

Rocky open woods and thickets. Circumneutral. General.

Sanicula canadensis L.

Rocky open woods and thickets. Circumneutral. General.

Sanicula Smallii Bicknell.

Rich woods. Circumneutral. Southeastern Mo.: Ripley Co.

Erigenia bulbosa (Michx.) Nutt. Harbinger-of-spring.

Rich woods, alluvial thickets, and along the base of rocky bluffs. Circumneutral to calciphile. East-central and southern Mo.: Randolph, Boone, Audrain, Callaway, Montgomery, Warren, St. Louis, Jefferson, Franklin, Gasconade, Washington, St. Francois, Ste. Genevieve, Madison, Bollinger, Wayne, Shannon, Phelps, Pulaski, Moniteau, Laclede, Greene, Taney, Douglas, and Jasper counties.

Chaerophyllum procumbens (L.) Crantz. Wild Chervil.

Rich or rocky open woods, thickets, glades, and open alluvial ground. Circumneutral. General.

Chaerophyllum procumbens var. **Shortii** T. & G.

Chaerophyllum Shortii (T. & G.) Bush (S).

Similar situations to the preceding. Scattered: St. Louis, Taney, and Jackson counties.

Chaerophyllum texanum Coult. & Rose. See Rh. **11**: 52. 1909.

Rocky prairies and glades. Circumneutral. Central and southern Mo.: Bollinger, Boone, Taney, Jackson, St. Clair, Greene, Barry, Vernon, Jasper, and Newton counties.

Chaerophyllum Tainturieri Hook. var. **floridanum** Coult. & Rose.
Glades and rocky waste ground. Southern Mo., scattered: Dunklin, Butler, Barry, and Jasper counties.

Osmorhiza Claytoni (Michx.) Clarke. Woolly Sweet Cicely.
Rich woods and thickets. Circumneutral. General.

Osmorhiza longistylis (Torr.) DC. Smooth Sweet Cicely.
Rich woods and thickets. Circumneutral. General.

Osmorhiza longistylis var. **villicaulis** Fernald.
Sometimes found with the typical form. Scattered.

Spermolepis patens (Nutt.) Robinson.
Rocky prairies and glades. Circumneutral. General but scattered: Macon, Boone, St. Louis, Jefferson, Scott, Clay, Jackson, Greene, Taney, Barry, Jasper, and Newton counties.

Spermolepis echinata (Nutt.) Heller.
Rocky prairies, glades, and sandy or gravelly ground along streams. Oxylophile. Bollinger, Scott, Iron, Carter, Ripley, Polk, Jasper, and Newton counties.

CONIUM MACULATUM L. Poison Hemlock.
Waste ground and along railroads and roadsides. Indifferent. Central and southern Mo., scattered: St. Louis, Washington, Madison, Cole, Saline, Lawrence, Jasper, and Newton counties.

Ptilimnium capillaceum (Michx.) Raf. Mock Bishop's-weed.
Swamps and prairie swales. Circumneutral. East-central and southern Mo., scattered: St. Louis, Jefferson, New Madrid, Butler, Ripley, Greene, and Jasper counties.

Ptilimnium Nuttallii (DC.) Britton.
Prairie swales, wet meadows, and depressions in glades. Circumneutral to oxylophile. Central and southern Mo.: St. Louis, Jefferson, Franklin, Iron, Wayne, Bollinger, Mississippi, Dunklin, Butler, Ripley, Pulaski, Howell, Greene, Jackson, Vernon, Barry, Jasper, Newton, and McDonald counties.

Cicuta maculata L. Spotted Cowbane.
Borders of ponds, sloughs, and prairie streams. Circumneutral. General.

CARUM CARVI L. Caraway.
Occasionally escaped from gardens to roadsides and waste ground. Indifferent. Scattered: Boone and Jackson counties.

Sium suave Walt. See Rh. **17**: 131. 1915. Water Parsley.
Sium cicutaefolium J. F. Gmel. (G), (B & B).
Swamps and wet prairies. Circumneutral. Northern, central, and eastern Mo.: Shelby, St. Charles, St. Louis, Mississippi, New Madrid, Dunklin, Ripley, Boone, Livingston, and Jackson counties.

Cryptotaenia canadensis (L.) DC. Honewort.
Rocky woods and ledges along bluffs. Circumneutral. General.

Zizia aurea (L.) Koch. Golden Alexanders, Meadow Parsnip.
Rich rocky woods and thickets. Circumneutral to calciphile. General.

Zizia cordata (Walt.) DC.

Rich rocky woods, thickets, and prairies. Circumneutral. Central and southern Mo.: St. Louis, Jefferson, Franklin, Madison, Iron, Reynolds, Carter, Oregon, Shannon, Boone, Hickory, Taney, Stone, Barry, Jackson, Jasper, and McDonald counties.

Taenidia integerrima (L.) Drude. Yellow Pimpernel.

Rocky open woods and ledges along bluffs. Calciphile to circumneutral. General, but commonest in the Ozark region.

Eulophus americanus Nutt.

Rocky open woods and glades. Calciphile to circumneutral. East-central and southern Mo.: Franklin, Jefferson, Washington, Phelps, Shannon, Texas, Greene, Wright, Webster, Taney, Barry, Jasper, and Newton counties.

BUPLEURUM ROTUNDIFOLIUM L. Thorough-wax.

Fields and waste ground. Circumneutral. Scattered: Jefferson, Franklin, Washington, and Clay counties.

Cynosciadium pinnatum DC.

Pools and wet depressions in glades. Oxylophile. Southwestern Mo.: Newton and McDonald counties.

Cynosciadium digitatum DC.

Low wet woods and swamps. Circumneutral to oxylophile. Southeastern Mo., local: Dunklin Co.

Ligusticum canadense (L.) Britton. Angelico.

Rocky woods and moist ground along streams. Circumneutral to oxylophile. Southern Mo.: Iron, Bollinger, Ripley, Oregon, Shannon, Texas, Howell, Wright, Webster, Douglas, Stone, and McDonald counties.

CORIANDRUM SATIVUM L. Coriander.

Occasionally escaped from gardens to roadsides and waste ground. Indifferent. Scattered: St. Louis, Boone, and Jackson counties.

FOENICULUM VULGARE Hill. Fennel.

Sometimes escaping from gardens to roadsides and waste ground. Indifferent. Scattered: St. Louis, Boone, and Jackson counties.

Thaspium barbinode (Michx.) Nutt.

Rocky open woods, and along banks and bluffs of streams. Circumneutral to oxylophile. Eastern, southern, and central Mo.

Thaspium trifoliatum (L.) Gray var. **flavum** Blake, Rh. **20**: 53. 1918.

Thaspium aureum of auth., not Nutt. (G).

Thaspium trifoliatum (L.) Britton, in part (B & B).

Thickets and rocky prairies. Circumneutral. General.

Cogswellia daucifolia (Nutt.) M. E. Jones, Contr. West. Bot. 12: 34. 1908.

Lomatium daucifolium (Nutt.) Coult. & Rose (G).

Limestone glades. Calciphile. West-central Mo.: Jackson and Cass counties.

Polytaenia Nuttallii DC. Prairie Parsley.

Rocky prairies and glades. Calciphile to circumneutral. General.

PASTANICA SATIVA L. Parsnip.

Escaped from cultivation and common in field, waste ground, and along roadsides and railroads. Indifferent. General.

Heracleum lanatum Michx. Cow Parsnip.

Moist rich woods and thickets. Circumneutral. Scattered: St. Louis, Cass, and Jasper counties.

LEVISTICUM OFFICINALE (L.) Koch. Lovage.

Escaped from cultivation to waste ground and roadsides. Washington Co.

ANETHUM GRAVEOLENS L. Dill.

Cultivated and rarely escaped to roadsides and waste ground. Jackson Co.

Oxypolis rigidior (L.) Coult. & Rose. Cowbane.

Moist shaded bluffs and wet ground along streams. Calciphile to circumneutral. Eastern, central, and southern Mo.: Shelby, St. Louis, Jefferson, Franklin, Washington, Iron, Bollinger, Reynolds, Carter, Ripley, Shannon, Dent, Pulaski, Laclede, Dallas, Texas, Polk, Howell, Douglas, Greene, Taney, Barry, Jasper, and Jackson counties.

Oxypolis rigidior var. **ambigua** (Nutt.) Robinson.

In similar situations to the typical form. Calciphile to circumneutral. Eastern and southern Mo.: Shelby, Dent, Iron, Shannon, Texas, and Laclede counties.

Conioselinum chinense (L.) BSP. Hemlock Parsley.

Waste ground and along small streams. Indifferent. Southwestern Mo.: Christian, Lawrence, and Jasper counties.

Angelica villosa (Walt.) BSP. Wood Angelica.

Rocky woods and glades. Circumneutral to oxylophile. Southern Mo.: Crawford, Iron, Carter, Shannon, Oregon, Dent, Phelps, Texas, Howell, Ozark, Pulaski, Wright, Webster, Douglas, Greene, Barry, and McDonald counties.

TORILIS ANTHRISCUS (L.) Bernh. Hemlock Chervil.

Roadsides and waste ground. Indifferent. Recently introduced in many places and becoming general: Schuyler, Jefferson, Carter, Oregon, Howell, Boone, Saline, Camden, Pulaski, Phelps, Benton, Dallas, Wright, Douglas, Greene, Clay, Jackson, Cass, Johnson, Cedar, Vernon, Jasper, and McDonald counties.

Daucus pusillus Michx.

Rocky prairies and glades. Circumneutral to oxylophile. Scattered, but commonest in southwestern Mo.: Schuyler, Linn, Benton, Ozark, Taney, Stone, Barry, Jasper, Newton, and McDonald counties.

DAUCUS CAROTA L. Queen Anne's Lace, Carrot.

Fields, waste ground, and along railroads and roadsides. Indifferent. Escaped from cultivation. General.

Fam. CORNACEAE

Cornus florida L. Flowering Dogwood.

Rocky open woods, bluffs, and thickets. Circumneutral to oxylophile. Eastern, central, and southern Mo.; common in the Ozark region.

Cornus florida f. **rubra** (West) Palmer & Steyermark, comb. nov.

Cornus florida var. *rubra* West.

Rarely found with the typical form. Jasper Co.

Cornus alternifolia L. f. Pigeon Berry, Alternate-leaved Dogwood.

Along bluffs and banks of streams. Circumneutral to oxylophile. Eastern and middle Mo., mostly along the larger rivers and locally in the eastern Ozark region: Clark, Lewis, Boone, Callaway, St. Louis, Jefferson, Dent, Shannon, and Texas counties.

Cornus obliqua Raf. Kinnikinnik, Swamp Dogwood.

Cornus Purpusi Koehne.

Cornus Amomum of auth. in part, not Mill. (G), (B & B).

Thickets, wet prairies, bogs, and along beds of small streams. Circumneutral. General, and probably in every county.

Cornus asperifolia Michx. Rough-leaved Dogwood.

Thickets and borders of woods; in dry rocky, or sometimes in moist, alluvial ground. Circumneutral. General, and probably in every county.

Cornus femina Mill. Stiff Dogwood.

Cornus stricta Lam. (G). (B & B).

Swamps and low open ground. Circumneutral. Southeastern Mo.: Cape Girardeau, Bollinger, Scott, Mississippi, New Madrid, Dunklin, Stoddard, Butler, Ripley, Carter, Reynolds, and Iron counties.

Cornus racemosa Lam. Gray Dogwood.

Cornus paniculata L'Her. (G).

Cornus femina of auth., not Mill. (B & B).

Low woods and thickets, and wet rocky ground along streams. Circumneutral. General but scattered.

Nyssa sylvatica Marsh. Black Gum.

Rocky or alluvial woods along streams and hillsides. Circumneutral to oxylophile. Central and southern Mo., south and east of a line drawn from Jefferson, Franklin, Cole, and Benton counties to Newton Co.

Nyssa aquatica L. Tupelo.

Swamps and low wet woods. Circumneutral. Southeastern Mo.: Bollinger, Cape Girardeau, Scott, Mississippi, New Madrid, Pemiscot, Dunklin, Stoddard, Butler, and Ripley counties.

Fam. Ericaceae

Monotropa uniflora L. Indian Pipe, Ghost Flower.

Woods and thickets. Oxylophile to circumneutral. General but scattered: Macon, Boone, Lincoln, St. Louis, Ste. Genevieve, Franklin, Jefferson, Washington, Crawford, Stoddard, Dunklin, Butler, Carter, Shannon, Howell, Ozark, Webster, Greene, Stone, Harrison, Platte, Jackson, Jasper, Newton, and McDonald counties.

Monotropa Hypopitys L. Pinesap.

Rich or rocky woods, and gravelly banks. Oxylophile. East-central and southern Mo., scattered: St. Louis, Jefferson, Ste. Genevieve, Shannon, Greene, Jasper, Newton, and McDonald counties.

Rhododendron nudiflorum (L.) Torr. var. **roseum** (Lois.) Wiegand, Rh. **26**: 4. 1924. Wild Honeysuckle.

Rhododendron nudiflorum Torr., in part (G).

Azalea nudiflora L., in part (B & B).

Rocky wooded hillsides and bluffs. Oxylophile: usually on siliceous or granitic rocks. Southern Mo., mainly in the eastern Ozark region: Ste. Genevieve, Cape Girardeau, Bollinger, Madison, Iron, Reynolds, Wayne, Ripley, Douglas, and Ozark counties.

Vaccinium arboreum Marsh. Farkleberry.

Rocky woods and bluffs: Oxylophile. Southern Mo.: Perry, Bollinger, Oregon, Gasconade, Shannon, and Howell counties.

Vaccinium arboreum var. **glaucescens** (Greene) Sarg.

Batodendron glaucescens Greene (S).

Batodendron andrachnaeforme Small (S).

Rocky woods and bluffs. Oxylophile; usually on siliceous or granitic rocks. East-central and southern Mo.: Lincoln, St. Louis, Jefferson, Ste. Genevieve, St. Francois, Perry, Bollinger, Madison, Iron, Reynolds, Wayne, Butler, Dunklin, Washington, Carter, Ripley, Oregon, Shannon, Dent, Crawford, Gasconade, Phelps, Pulaski, Texas, Howell, Douglas, Ozark, Taney, Stone, Barry, Jasper, Newton, and McDonald counties.

Vaccinium stamineum L. High-bush Huckleberry, Deerberry.

Rocky woods and glades. Oxylophile. Southern Mo.: Washington, St. Francois, Ste. Genevieve, Iron, Madison, Bollinger, Wayne, Carter, Ripley, Oregon, Shannon. Texas, Howell, Douglas, Webster, Ozark, Greene, Christian, Taney, Stone, Barry, Newton, and McDonald counties.

Vaccinium stamineum var. **neglectum** (Small) Deam, Indiana Dept. Conserv. Publ. 44: 288. rev. ed. 1932.

Polycodium neglectum Small (S).

Vaccinium neglectum (Small) Fernald (G).

Rocky open woods and glades. Oxylophile. Southern Mo.: Ste. Genevieve, Bollinger, Madison, Iron, Reynolds, Wayne, Dunklin, Ripley, Carter, Oregon, Shannon, Dent, Texas, Howell, Douglas, Webster, Ozark, Taney, Stone, Cedar, Barry, and McDonald counties.

Vaccinium stamineum var. **interius** (Ashe) Palmer & Steyermark, comb. nov.

Polycodium interius Ashe, Jour. Elisha Mitchell Sci. Soc. **46**: 210. 1931.

Rocky open woods. Oxylophile. Southern Mo., scattered: Shannon and Barry counties.

Vaccinium melanocarpum Mohr. High-bush Huckleberry, Southern Gooseberry.

Rocky open woods. Oxylophile. Southern Mo.: Wayne, Carter, Barry, and McDonald counties.

Vaccinium virgatum Ait. var. **tenellum** (Ait.) Gray.

Moist sandy or rocky ground. Oxylophile. Southeastern Mo.: Ste. Genevieve, Bollinger, Madison, and Butler counties.

Vaccinium vacillans Kalm. Low-bush Huckleberry, Low-bush Blueberry.

Rocky open woods, glades, and bluffs. Oxylophile. Southern Mo., scattered and mostly in the eastern Ozark region: Jefferson, St. Francois, Madison, Iron, Dunklin, Shannon, and McDonald counties.

Vaccinium vacillans var. **crinitum** Fernald, Rh. **13**: 236. 1911.

Vaccinium missouriense Ashe.

Rocky open woods, glades, and bluffs. Oxylophile. Central and southern Mo., south and east of a line drawn from Lincoln, Boone, and Henry counties to Jasper Co. This is the commonest form in Missouri and throughout the Ozark region.

Fam. PRIMULACEAE

Androsace occidentalis Pursh.

Rocky prairies, fields, glades, open woods, and bluffs. Calciphile to circumneutral. Eastern, southern, and central Mo., south and east of a line drawn from Marion and Boone counties to Jackson Co., and locally northwest in Daviess Co.

Hottonia inflata Ell. Water Violet.

Swamps, sloughs, and bayous. Circumneutral to oxylophile. Eastern Mo., south of the Missouri River: St. Louis, Jefferson, Bollinger, Wayne, and Dunklin counties.

Samolus parviflorus Raf. Water Pimpernel.

Samolus floribundus HBK. (G), (B & B).

Low wet woods, swamps, spring branches, and wet ledges along bluffs. Calciphile to circumneutral. East-central and southern Mo.: Ralls, Randolph, Boone, Callaway, Montgomery, Warren, St. Louis, Jefferson, Franklin, Ste. Genevieve, St. Francois, Perry, Bollinger, Madison, Mississippi, Dunklin, Butler, Wayne, Ripley, Carter, Reynolds, Oregon, Dent, Shannon, Howell, Texas, Crawford, Phelps, Miller, Morgan, Benton, St. Clair, Hickory, Polk, Dallas, Laclede, Douglas, Ozark, Taney, Greene, Stone, Barry, Jasper, and McDonald counties.

Lysimachia thyrsiflora L. Tufted Loosestrife.

Swamp and bogs. Circumneutral to oxylophile. Western Mo., local: Jackson Co.

LYSIMACHIA NUMMULARIA L. Moneywort.

Low wet woods and boggy open ground. Circumneutral. Scattered: Marion, Boone, St. Louis, Perry, Madison, Oregon, Gasconade, Platte, Clay, and Jackson counties.

Steironema ciliatum (L.) Raf.

Moist open woods, prairie swales, and banks of ponds and streams. Circumneutral. General.

Steironema radicans (Hook.) Gray.

Low wet woods, and borders of streams and bayous. Circumneutral. Bollinger, Stoddard, New Madrid, Pemiscot, Dunklin, Butler, and Ripley counties.

Steironema lanceolatum (Walt.) Gray.

Wet or rocky dry woods, thickets, swamps, and banks of streams. Oxylophile to circumneutral. Eastern, southern, and central Mo.: Knox, Shelby, Randolph, Boone, Audrain, Callaway, Montgomery, Lincoln, St. Louis, Jefferson, Franklin, Washington, Ste. Genevieve, Bollinger, Madison, Wayne, Iron, Reynolds, Carter, Ripley, Oregon, Crawford, Dent, Phelps, Maries, Cole, Wright, Webster, Greene, Ozark, Jackson, Cass, Jasper, and McDonald counties.

Steironema lanceolatum var. **angustifolium** (Lam.) Gray.

Occasionally found with the typical form. Scattered: Jefferson, Shannon, and Greene counties.

Steironema lanceolatum var. **hybridum** (Michx.) Gray.

Low open ground. Circumneutral. Scattered: Knox, St. Louis, Mississippi, Boone, and Jackson counties.

Steironema quadriflorum (Sims) Hitchc. Crosswort, Whorled Loosestrife.

Low wet woods and rocky banks of streams. Calciphile to circumneutral. East-central and southern Mo.: St. Louis, Jefferson, Washington, Iron, Butler, Ripley, Oregon, Shannon, Dent, Crawford, Phelps, Laclede, Texas, Howell, Douglas, Ozark, Greene, and Taney counties.

Anagallis arvensis L. Poor Man's Weatherglass, Scarlet Pimpernel.

Fields, glades, and waste ground. Circumneutral. Central and southern Mo.: St. Louis, Jefferson, Franklin, Washington, Ste. Genevieve, Bollinger, Madison, Boone, Phelps, Ozark, Miller, Polk, Greene, and McDonald counties.

Anagallis arvensis var. caerulea (Schreb.) Ledeb.

Similar situations to the typical form. Scattered: St. Louis, Franklin, Gasconade, and Miller counties.

Centunculus minimus L. Chaffweed.

Meadows, prairies, and glades. Circumneutral. Central and southern Mo., scattered: Boone, St. Charles, St. Louis, Jefferson, Crawford, Shannon, Greene, Barry, Jackson, Jasper, and McDonald counties.

Dodecatheon Meadia L. Shooting Star.

Prairies, glades, bluffs, and moist wooded hillsides. Circumneutral to oxylophile. General but uncommon in many localities.

Fam. Sapotaceae

Bumelia lycioides (L.) Pers. Southern Buckthorn.

Low woods. Circumneutral. Southeastern Mo.: Pemiscot and Butler counties.

Bumelia lanuginosa (Michx.) Pers. Chittim-wood, Gum-elastic.

Dry rocky woods, bluffs, and glades. Circumneutral. Central and southern Mo., south of a line drawn from Lincoln, Boone, Pettis and St. Clair to Barton Co.

Fam. Ebenaceae

Diospyros virginiana L. Persimmon.

Prairies, borders of woods, and along small streams. Circumneutral. General but commonest in central and southern Mo.

Diospyros virginiana f. **pumila** Palmer & Steyermark, f. nov.

Rocky open woods and glades. West-central Mo.: Jackson and Bates counties.

Frutex 2–4 m. altus vel raro arbor ad 7–8 m. alta; a typo differt foliis minoribus dense pubescentibus; ramulis novellis, petiolis sepalisque dense pubescentibus.

This form differs from the variety *pubescens* in its usually shrubby habit, in the generally smaller leaves, and the more densely tomentose branchlets, foliage, and calyx. It differs from the variety *platycarpa* in the much smaller, more pubescent leaves, and in the smaller fruit, which is oblong or subglobose and not flattened or depressed. The leaves of this proposed form are oblong or oblong-

lanceolate, rounded or abruptly pointed at the apex, usually rounded or subcordate at the base, ciliate on the margins, dark green and scabrate above when young, but becoming glabrous, permanently densely pubescent on the pale under surface. The short stout petioles (8–15 mm. long) are densely pubescent, as is also the calyx.

MISSOURI: Dodson, June 6, 1913, *B. F. Bush 7041* (Arn. Arb. TYPE); Westport, June 10, 1900, *B. F. Bush 787* (Arn. Arb.); Greenwood, June 5, 1923, *B. F. Bush 10092* (Arn. Arb.); Greenwood, Sept. 5, 1924, *E. J. Palmer 26030* (Arn. Arb.); Monteith Junction, Bates Co., Sept. 10, 1924, *E. J. Palmer 26080* (Arn. Arb.); ARKANSAS: Hot Springs, Garland Co., April 21, Oct. 9, 1925, *E. J. Palmer 26840, 29109* (Arn. Arb.).

Although the American persimmons vary greatly in foliage and fruit, it is difficult to find constant characters on which to separate the different forms. The one here described looks so well marked that it might well be regarded as a distinct species or variety, but since a specimen cultivated at the Arnold Arboretum from seed collected at the type locality does not retain the distinctive shape of the small leaves, it is perhaps best to regard it as an ecological form.

Diospyros virginiana var. **platycarpa** Sarg. Jour. Arnold Arb. **2**: 168. 1921.

Circumneutral to calciphile. East-central and southern Mo., scattered: St. Louis, Dunklin, Carter, Shannon, Christian, Barton, and Jasper counties.

Diospyros virginiana var. **pubescens** (Pursh) Dippel, Handb. Laubholzk. **1**: 306. 1889.

Diospyros pubescens Pursh.

Frequently found with the typical form. Scattered: Marion, Ralls, Boone, Callaway, St. Louis, Wayne, Oregon, Ozark, Johnson, Greene, Stone, and McDonald counties.

Fam. STYRACACEAE

Styrax americana Lam. Smooth Storax.

Swamps and low wet woods. Circumneutral to oxylophile. Southeastern Mo.: Bollinger, Mississippi, New Madrid, Pemiscot, Dunklin, Butler, and Ripley counties.

Fam. OLEACEAE

Fraxinus americana L. White Ash.

Upland woods, glades, and borders of streams. Circumneutral. General, and probably in every county.

Fraxinus americana var. **subcoriacea** Sarg. Bot. Gaz. **67**: 241. 1919.

Low woods. Circumneutral. Southeastern Mo.: Dunklin Co.

Fraxinus pennsylvanica Marsh. Red Ash.

Woods along streams, and borders of lakes and ponds. Circumneutral. Northern and central Mo., scattered: Scotland, Adair, Marion, St. Louis, Saline, Atchison, and Jackson counties.

Fraxinus pennsylvanica var. **lanceolata** (Borkh.) Sarg. Green Ash.

Low woods, swamps, and borders of streams. Circumneutral. General, and probably in every county.

Fraxinus profunda Bush. Pumpkin Ash.

Low wet woods and swamps. Circumneutral. Southeastern Mo.: Cape Girardeau, Mississippi, New Madrid, Pemiscot, Dunklin, Stoddard, Butler, and Ripley counties.

Fraxinus profunda var. **Ashei** Palmer, Jour. Arnold Arb. **13**: 417–418. 1932.

Occasionally found with the typical form. Dunklin Co.

Fraxinus quadrangulata Michx. Blue Ash.

Bluffs, glades, rocky upland woods, and rarely in alluvial ground along streams. Calciphile to circumneutral. Eastern, central, and southern Mo. and locally north to Livingston Co.: Marion, Ralls, Pike, Monroe, Randolph, Livingston, Saline, Howard, Cooper, Boone, St. Charles, St. Louis, Franklin, Jefferson, Crawford, Washington, Iron, Madison, Bollinger, Mississippi, Butler, Oregon, Dent, Shannon, Texas, Phelps, Laclede, Miller, Benton, Hickory, Dallas, Howell, Ozark, Greene, Christian, Taney, Stone, Barry, Jasper, and McDonald counties.

Fraxinus biltmoreana Beadle.

Woods and hillsides. Circumneutral. Southeastern Mo.: Dunklin Co.

Forestiera acuminata (Michx.) Poir. Swamp Privet.

Swamps, low woods, and borders of streams and bayous. Circumneutral. Eastern and southern Mo., mainly along the Mississippi and White River: Marion, Pike, Lincoln, St. Charles, St. Louis, Jefferson, Ste. Genevieve, Perry, Mississippi, New Madrid, Stoddard, Dunklin, Pemiscot, Butler, Taney, Stone, and Jasper counties.

Chionanthus virginica L. Old Man's Beard, Fringe Tree.

Low open woods and along bluffs. Circumneutral to oxylophile. Southern Mo., scattered and rare: Mississippi and Ozark counties.

Fam. LOGANIACEAE

Spigelia marilandica L. Pink-root.

Low open woods and moist thickets. Circumneutral to oxylophile. Southeastern Mo.: St. Francois, Cape Girardeau, Dunklin, Butler, Ripley, and Oregon counties.

Polypremum procumbens L.

Sandy open ground. Oxylophile. Southeastern Mo.: Mississippi and Dunklin counties.

Fam. GENTIANACEAE

Sabatia campestris Nutt. Prairie Pink.

Prairies, fields, and glades. Circumneutral to calciphile. Central and southern Mo., scattered: Boone, Montgomery, Dent, Shannon, Greene, Clay, Jackson, Vernon, Jasper, and Newton counties.

Sabatia angularis (L.) Pursh. Rose Pink.

Rocky open woods, thickets, and glades. Circumneutral to calciphile. Eastern, central, and southern Mo.: Shelby, Randolph, Boone, Callaway, Montgomery, Lincoln, St. Charles, St. Louis, Jefferson, Franklin, Gasconade, Ste.

Genevieve, Perry, Bollinger, Stoddard, New Madrid, Dunklin, Butler, Ripley, Oregon, Shannon, Howell, Texas, Phelps, Pulaski, Laclede, Camden, Miller, Cole, Polk, Greene, Taney, Stone, Barry, Vernon, Jasper, Newton, and McDonald counties.

Centaurium texense (Griseb.) Fernald. Centaury.
Glades and bald knobs. Calciphile. Central and southwestern Mo.: Miller, Greene, Christian, Taney, and Barry counties.

Centaurium calycosum (Buckley) Fernald.
Introduced along railways. Jackson Co.

Gentiana quinquefolia L. var. **occidentalis** (Gray) Hitchc. Ague Weed.
Rocky wooded banks and bluffs of streams. Oxylophile to circumneutral. Eastern Mo.: Clark, Adair, Jefferson, Ste. Genevieve, Iron, Reynolds, Carter, and Shannon counties. This has been confused with the typical form which is not known to occur in Mo.

Gentiana puberula Michx. Purple Gentian.
Prairies and glades. Circumneutral to calciphile. General, but not common: Schuyler, Adair, Macon, Randolph, Shelby, Marion, Monroe, Ralls, Pike, Audrain, St. Louis, Crawford, Shannon, Phelps, Maries, Pulaski, Wright, Webster, Greene, Taney, Lawrence, Barry, Daviess, Saline, Randolph, Jackson, Cass. Hickory, Cedar, Jasper, and McDonald counties.

Gentiana Andrewsii Griseb. Closed Gentian.
Wet open woods, and borders of ponds and streams. Circumneutral. Scattered: St. Louis, Ste. Genevieve, Dent, Boone, Jackson, and Jasper counties.

Gentiana clausa Raf. See Rh. **19**: 149. 1917. Closed Gentian.
Prairie swales, moist banks, and low ground along streams. Circumneutral. General but scattered: Schuyler, Adair, Macon, Osage, Iron, Butler, Oregon, Texas, Douglas, Saline, Jackson, Cass, and Polk counties. This has sometimes been confused with the last species and with *Gentiana Saponaria*.

Gentiana flavida Raf. Pale Gentian.
Rocky prairies, thickets, and glades. Circumneutral. General but scattered: Schuyler, Sullivan, Ralls, Warren, St. Louis, Franklin, Scott, Shannon, Texas, Phelps, Maries, Morgan, Jackson, Cass, Greene, Taney, Stone, Barry, Jasper, and Newton counties.

Frasera caroliniensis Walt. American Columbo.
Rocky open woods and thickets. Oxylophile. Southeastern Mo., mostly in the eastern Ozark region: Maries, Jefferson, Ste. Genevieve, St. Francois, Bollinger, Washington, Madison, Wayne, Iron, and Scott counties.

NYMPHOIDES PELTATUM (S. P. Gmel.) Britten & Rendle. Floating Heart.
Introduced in ponds. Scattered: St. Louis, Iron, and Newton counties.

Fam. APOCYNACEAE

Amsonia Tabernaemontana Walt.
Rich woods and thickets. Circumneutral to oxylophile. East-central and southern Mo.: St. Louis, Jefferson, Franklin, Polk, Greene, Webster, Douglas, Taney, Stone, Lawrence, Barry, Jasper, Newton, and McDonald counties.

Amsonia Tabernaemontana var. **salicifolia** Woodson, Ann. Mo. Bot. Gard. **15**: 406. 1928.

Alluvial thickets and rich ground along bluffs. Circumneutral. Scattered: Pike, St. Louis, Jefferson, Dent, Ripley, Greene, Christian, and McDonald counties.

Amsonia Tabernaemontana var. **Gattingeri** Woodson, Ann. Mo. Bot. Gard. **15**: 408. 1928.

Rich open woods along bluffs and streams. Circumneutral. East-central and southern Mo.: Lincoln, St. Louis, Lawrence, and Jasper counties.

Amsonia illustris Woodson, Ann. Mo. Bot. Gard. **16**: 407. 1929.

Rocky open ground and gravel bars of streams. Circumneutral. Central and southern Mo.: Lincoln, St. Louis, Franklin, Jefferson, Crawford, Carter, Ripley, Oregon, Dent, Shannon, Osage, Miller, Phelps, Maries, Pulaski, Laclede, Hickory, Dallas, Stone, Jasper, Newton, and McDonald counties.

Amsonia ciliata Walt. var. **tenuifolia** (Raf.) Woodson, Ann. Mo. Bot. Gard. **15**: 400. 1928.

Glades and bald knobs. Circumneutral to calciphile. Southern Mo.: Douglas and Ozark counties.

Trachelospermum difforme (Walt.) Gray.

Swamps and borders of bayous. Circumneutral. Southeastern Mo.: Stoddard, Dunklin, Butler, and Ripley counties, and also in St. Louis Co.

Apocynum androsaemifolium L. Pink-flowered Dogbane.

Apocynum sylvaticum Greene.

Thickets and dry rocky woods. Circumneutral to oxylophile. General but scattered: Mercer, Putnam, Sullivan, Adair, St. Louis, Jefferson, Iron, Shannon, Howell, Boone, Miller, Morgan, Dallas, Wright, Douglas, Webster, Greene, Lawrence, Barry, and Jasper counties.

Apocynum cannabinum L. Indian Hemp, Dogbane.

Rocky prairies, open woods, and glades. Circumneutral. East-central and southern Mo., scattered: St. Louis, Iron, Oregon, Phelps, Stone, and McDonald counties.

Apocynum cannabinum var. **glaberrimum** A. DC.

Rocky open woods, thickets, and waste ground. Circumneutral. General.

Apocynum cannabinum var. **pubescens** (Mitchell) A. DC.

Rocky open woods, thickets, and waste ground. Circumneutral. General.

Apocynum medium Greene.

Rocky open woods and thickets. Circumneutral to oxylophile. General.

Apocynum medium var. **leuconeuron** (Greene) Woodson, Ann. Mo. Bot. Gard. **17**: 112. 1930.

Similar situations to the preceding. Circumneutral to oxylophile. General but scattered.

Apocynum hypericifolium Ait.

Apocynum cannabinum var. *hypericifolium* (Ait.) Gray (G).

Rocky stream beds and alluvial soil. Circumneutral to calciphile. Northern and central Mo., and locally south in Texas Co.: Mercer, Boone, St. Charles, St. Louis, Andrew, Carroll, Jackson, and Texas counties.

Apocynum hypericifolium var. **cordigerum** (Greene) Beg. & Bel. Atti R. Accad. Lincei, V. **9**: 114. 1913.

In similar situations to the typical form. Circumneutral to calciphile. Northern and central Mo., scattered: Scotland, Dekalb, Livingston, Macon, and Jackson counties.

VINCA MINOR L. Periwinkle.

Cultivated and occasionally escaped. Indifferent. Scattered: Marion, St. Charles, St. Louis, Jefferson, Scott, Texas, and Clay counties.

Fam. ASCLEPIADACEAE

Asclepiodora viridis (Walt.) Gray.

Rocky prairies and glades. Calciphile to circumneutral. Central and southern Mo.: St. Louis, Jefferson, Washington, St. Francois, Ste. Genevieve, Bollinger, Butler, Ripley, Oregon, Carter, Shannon, Phelps, Miller, Douglas, Wright, Ozark, Taney, Stone, Barry, Vernon, Barton, Jasper, Newton, and McDonald counties.

Asclepias tuberosa L. Butterfly-weed.

Rocky open woods, prairies, and glades. Circumneutral. General.

Asclepias tuberosa f. **lutea** Clute, Am. Bot. **18**: 73. 1912.

Occasionally found with the typical form. Jefferson Co.

Asclepias purpurascens L. Purple Milkweed.

Rocky open woods, thickets, and glades. Circumneutral. General. This has sometimes been confused with *Asclepias exaltata (A. phytolaccoides)* which is not known to occur in Mo.

Asclepias incarnata L. Swamp Milkweed.

Low wet woods, and borders of ponds, sloughs, and prairie streams. Circumneutral. General.

Asclepias speciosa Torr.

Open ground. Circumneutral. Local: St. Louis Co.

Asclepias syriaca L. var. **kansana** (Vail) Palmer & Steyermark, comb. nov.

Asclepias kansana Vail (B & B).

Asclepias syriaca of auth., in part (G), (B & B).

Open woods, fields, and waste ground. Circumneutral. General and common.

Typical *Asclepias syriaca* with few and short prickles on the seed pods is more eastern and has not been found in Mo.

Asclepias Sullivantii Engelm.

Prairies and thickets. Circumneutral. Northern and central Mo.: Scotland, Schuyler, Gentry, Linn, Livingston, Chariton, Randolph, Lincoln, St. Charles, St. Louis, Atchison, Dekalb, Jackson, and Henry counties.

Asclepias humistriata Walt.

Asclepias amplexicaulis Michx., not Sm. (G), (B & B).

Rocky open woods, prairies, and glades. Circumneutral. Central and southern Mo., scattered: St. Louis, Scott, Mississippi, Shannon, Dent, Jackson, Greene, and Jasper counties.

Asclepias Meadii Torr.

Dry open woods and prairies. Circumneutral. Central and southern Mo., scattered: St. Louis, Iron, and Cass counties.

Asclepias variegata L.

Sandy open ground and dry rocky woods. Oxylophile to circumneutral. Southeastern Mo.: Scott, Dunklin, and Ripley counties.

Asclepias latifolia (Torr.) Raf.

Asclepias Jamesii Torr.

Prairies. Introduced in Jackson Co. Sometimes confused with *Asclepias humistriata* which it resembles.

Asclepias quadrifolia Jacq.

Rocky open woods. Oxylophile to circumneutral. Eastern, middle, and southern Mo.: Schuyler, Marion, Ralls, Monroe, Pike, Boone, Callaway, Cole, St. Louis, Jefferson, Franklin, St. Francois, Bollinger, Wayne, Iron, Madison, Ripley, Shannon, Texas, Phelps, Maries, Wright, Greene, Christian, Taney, Stone, Lawrence, Barry, Jasper, Newton, and McDonald counties.

Asclepias perennis Walt.

Low wet woods and borders of bayous. Circumneutral. Southeastern Mo.: Mississippi, New Madrid, Pemiscot, Dunklin, Stoddard, Butler, and Ripley counties.

Asclepias verticillata L. Whorled Milkweed.

Dry prairies, glades, and rocky bluffs. Circumneutral to oxylophile. General, but commonest in northern and central Mo.

Asclepias stenophylla Gray.

Acerates angustifolia (Nutt.) Dcne. (B & B).

Dry prairies, glades, and rocky bluffs. Calciphile to circumneutral. General but scattered: Pike, Lincoln, St. Charles, Jefferson, Pulaski, Hickory, Dallas, Ozark, Greene, Stone, Barry, Jackson, and Jasper counties.

Acerates hirtella Pennell, Bull. Torr. Bot. Club **46**: 184–185. 1919.

Acerates floridana of auth., not *Asclepias floridana* Lam. (G), (B & B).

Rocky prairies and glades. Circumneutral to oxylophile. General.

Acerates viridiflora Ell. Green Milkweed.

Rocky prairies and glades. Circumneutral. General.

Acerates viridiflora var. **lanceolata** (Ives) Gray.

In similar situations to the preceding. Circumneutral. General but scattered: Boone, Callaway, St. Louis, Jefferson, Washington, Phelps, Howell, Pettis, Cedar, Atchison, Jackson, Jasper, and McDonald counties.

Acerates viridiflora var. **linearis** Gray.

Sometimes found with the typical form. Scattered: Ste. Genevieve, Pulaski, Saline, Atchison, Holt, Buchanan, and Greene counties.

Gonolobus laevis Michx. Angle-pod, Sand Vine.

Moist alluvial woods, thickets, and cultivated fields. Circumneutral to oxylophile. General.

Vincetoxicum gonocarpos Walt.

Rocky woods and thickets along streams. Circumneutral. Southern Mo.: Mississippi, Dunklin, Ripley, Ozark, Barry, and Jasper counties.

Vincetoxicum obliquum (Jacq.) Britton.
Rocky woods and thickets. Circumneutral. Eastern Mo., south of the Missouri River: St. Louis, Madison, and Shannon counties.

Vincetoxicum carolinense (Jacq.) Britton. Climbing Milkweed.
Rocky open woods, thickets, and glades. Circumneutral to oxylophile. Central and southern Mo.: Warren, St. Louis, Jefferson, Franklin, St. Francois, Washington, Ste. Genevieve, Wayne, Carter, Ripley, Shannon, Dent, Phelps, Miller, Howell, Douglas, Wright, Benton, Greene, Barry, Jasper, and Newton counties.

Vincetoxicum Baldwinianum (Sweet) Britton.
Open woods and thickets along streams. Circumneutral. Southern Mo.: Phelps, Shannon, Taney, Stone, Lawrence, Barry, Jasper, Newton, and McDonald counties.

Fam. Convolvulaceae

Evolvulus argenteus Pursh.
Glades and bald knobs. Calciphile to circumneutral. East-central and southern Mo.: Montgomery, St. Louis, Jefferson, Franklin, Washington, Ripley, Oregon, Shannon, Douglas, Ozark, Taney, Greene, Stone, and Barry counties.

Evolvulus alsinioides L.
Rocky open ground. Local: St. Louis Co. Probably introduced.

IPOMOEA COCCINEA L. Red Morning Glory.
Fields, banks of streams, and waste ground. Indifferent. Scattered: Monroe, Boone, Cole, St. Louis, Scott, Reynolds, Greene, Jackson, and Jasper counties.

IPOMOEA QUAMOCLIT L. Cypress Vine.
Cultivated and rarely escaped into waste ground. Greene Co.

Ipomoea pandurata (L.) G. F. W. Mey. Man-of-the-earth.
Fields, thickets, and waste ground. Circumneutral. General: St. Louis, Franklin, Jefferson, Morgan, Benton, Greene, and Jasper counties.

Ipomoea pandurata var. **rubescens** Chois. See Rh. **20**: 65. 1918.
Similar situations to the preceding. Circumneutral. General. This is the common form in Missouri.

Ipomoea lacunosa L. Small White Morning Glory, Bindweed.
Thickets, roadsides, waste ground, and alluvial soils along streams and sloughs. Circumneutral. General: Linn, Boone, Lincoln, St. Charles, St. Louis, Jefferson, Madison, Scott, Mississippi, New Madrid, Pemiscot, Osage, Clay, Andrew, Jackson, Cass, Johnson, Vernon, Greene, Jasper, and Newton counties.

IPOMOEA PURPUREA (L.) Roth. Common Morning Glory.
Cultivated fields and waste ground. Indifferent. General, and probably in every county.

IPOMOEA HEDERACEA Jacq. Blue Morning Glory.
Cultivated fields and waste ground. Indifferent. General, and probably in every county.

Convolvulus spithamaeus L. Dwarf Morning Glory.
Rocky open woods and banks. Circumneutral. Eastern and central Mo.: Clark, St. Louis, Washington, Iron, and Jackson counties.

Convolvulus sepium L. Hedge Bindweed.
Fields, roadsides, and waste ground. Indifferent. General.

Convolvulus sepium var. **pubescens** (Gray) Fernald.
In similar situations to the preceding. Scattered: Schuyler, Scotland, Marion, Ralls, Monroe, St. Louis, Clay, Jackson, and Jasper counties.

Convolvulus sepium var. **fraterniflorus** Mack. & Bush.
Waste and cultivated ground. Indifferent. Central and southern Mo.: St. Louis, Jefferson, Osage, Jackson, Cass, and Jasper counties.

CONVOLVULUS ARVENSIS L. Small Bindweed.
Open banks, roadsides, and waste ground. Circumneutral. General.

CONVOLVULUS ARVENSIS var. OBTUSIFOLIUS Chois.
Occasionally found with the typical form. Scattered: Schuyler, St. Louis, Washington, Iron, and Jackson counties.

CONVOLVULUS JAPONICUS Thunb. Japanese Morning Glory, German Rose.
Roadsides and waste ground about dwellings. Escaped from cultivation. Scattered: St. Louis, Platte, Jackson, and Johnson counties.

Cuscuta Polygonorum Engelm. Smartweed Dodder.
Cuscuta obtusifolia HBK. (G).
Moist ground along streams and ponds, prairies, and thickets; on species of *Polygonum* and other herbs. General.

Cuscuta pentagona Engelm. See Univ. Ill. Biol. Monogr. **6**$^{2-3}$: 50. 1921. Field Dodder.
Cuscuta arvensis Beyrich (G), (B & B).
Thickets, prairies, and glades; on various herbs, especially Compositae. General.

Cuscuta pentagona var. **calycina** Engelm.
Occasionally found with the typical form. Jackson Co.

Cuscuta Cephalanthi Engelm.
Moist ground, thickets, and low woods; on various herbs and shrubs. General.

Cuscuta Coryli Engelm. Hazel Dodder.
Thickets and open ground, on herbs and shrubs, often on hazel. General but scattered: Knox, Montgomery, St. Louis, Gasconade, Jackson, Polk, Stone, Barry, Jasper, and McDonald counties.

Cuscuta Gronovii Willd. var. **vulgivaga** Engelm. See Univ. Ill. Biol. Monogr. **6**$^{2-3}$: 65. 121. 1921. Love-vine, Dodder.
Cuscuta Gronovii of auth., in part, not Willd. (G), (B & B).
Moist ground, thickets and prairies; on various herbs and shrubs. General.

Cuscuta cuspidata Engelm.
Low open woods, and borders of prairie streams; on *Ambrosia* and various other herbs and shrubs. Central and southern Mo.: St. Louis, Jefferson, Iron, Wayne, Dunklin, Greene, Jackson, and Jasper counties.

Cuscuta glomerata Chois.
Wet ground, prairie swales, and along small streams; on Compositae and other tall herbs. General.

Cuscuta compacta Juss.

Wet ground, low open woods and thickets; usually on shrubs. Eastern and southern Mo., south of the Missouri River: St. Louis, Jefferson, Franklin, Scott, New Madrid, Iron, Reynolds, Carter, Shannon, Howell, and Douglas counties.

Fam. Polemoniaceae

Phlox amplifolia Britton. See Bartonia 15: 15. 1933.

Rocky wooded hillsides. Circumneutral. Eastern Mo., south of the Missouri River: St. Louis and Reynolds counties.

Phlox paniculata L.

Moist woods and thickets, and gravel bars and banks along streams. Circumneutral. Central and southern Mo. south and east of a line from St. Louis, Warren, Montgomery, Cole, Camden, and Hickory to Vernon Co., and also locally north in Marion, Jackson, and Holt counties.

Phlox maculata L. var. **odorata** (Sweet) Wherry, Bartonia 14: 26. 1932. Wild Sweet William.

Rich moist woods. Circumneutral. Southeastern Mo., local: Iron Co.

Phlox glaberrima L. var. **melampyrifolia** (Salisb.) Wherry, Bartonia 14: 19. 1932.

Prairies and open woods. Circumneutral. Southeastern Mo.: Bollinger, Scott, Dunklin, Butler, Wayne, Iron, and Ripley counties.

Phlox glaberrima var. **interior** Wherry, Bartonia 14: 19. 1932.

Low open ground. Circumneutral. East-central Mo.: St. Louis and Jefferson counties.

Phlox pilosa L. var. **virens** (Michx.) Wherry, Bartonia 12: 47. 1931.

Rocky open woods, thickets, and prairies. Circumneutral to oxylophile. Eastern, central, and southern Mo., commonest in the Ozark region.

Phlox pilosa var. **fulgida** Wherry, Bartonia 12: 47. 1931.

Rocky open woods, thickets, and prairies. Circumneutral to oxylophile. Northern and western Mo.: Lewis, Marion, Ralls, Monroe, Shelby, Randolph, Macon, Adair, Putnam, Mercer, Daviess, Nodaway, Atchison, Platte, Jackson, Cass, and Vernon counties.

Phlox pilosa var. **fulgida** f. **albiflora** (MacM.) Standley, Rh. **34**: 176. 1932.

Occasionally found with the typical form. Scattered: Shelby, Adair, Marion, Randolph, Macon, and Putnam counties.

Phlox pilosa var. **ozarkana** Wherry, Am. Midl. Nat. **16**: 413–416. 1935.

Open rocky woods. Oxylophile to circumneutral. Southern and east-central Mo.: St. Louis, Jefferson, Iron, Carter, Wayne, Shannon, Texas, Christian, Wright, Barry, and McDonald counties.

Phlox divaricata L. var. **Laphamii** Wood. Blue Phlox, Wild Sweet William.

Rich or rocky woods and thickets. Circumneutral. General.

Phlox bifida Beck.

Phlox stellata Gray (G), (B & B), in part.

Rocky woods and open banks. Oxylophile to circumneutral. Scattered in southern Mo., and locally north in Randolph Co.: Randolph, Madison, Iron, Reynolds, Douglas, and Taney counties.

Phlox Drummondii Hook.

Introduced along railway. Southeastern Mo., local: Dunklin Co.

Gilia rubra (L.) Heller. Standing Cypress.

Plains and waste ground. Calciphile to circumneutral. Cultivated and escaped, except in northeastern Mo., where possibly native. Scattered: Clark, Holt, and Greene counties.

Collomia linearis Nutt. See Rh. **23**: 288. 1921.

Gilia linearis (Nutt.) Gray (G).

Meadows and along bluffs. Circumneutral. Northeastern Mo., local: Marion Co.

Polemonium reptans L. Jacob's Ladder, Greek Valerian.

Rich alluvial or rocky woods and thickets. Circumneutral. General.

Fam. HYDROPHYLLACEAE

Hydrophyllum canadense L. Waterleaf.

Rich woods and moist shaded hillsides. Circumneutral. Eastern Mo.: Warren, Franklin, St. Louis, Jefferson, and Stoddard counties.

Hydrophyllum virginianum L.

Rich moist woods and thickets and alluvial ground along streams. Circumneutral. General.

Hydrophyllum appendiculatum Michx. Woollen Breeches.

Rich woods and thickets. Circumneutral to calciphile. General but scattered: Schuyler, Adair, Macon, Lewis, Marion, Ralls, Pike, Randolph, Boone, Callaway, Warren, St. Charles, St. Louis, Jefferson, Franklin, Washington, St. Francois, Ste. Genevieve, Perry, Stoddard, Wayne, Dent, Reynolds, Oregon, Phelps, Pulaski, Cole, Camden, Laclede, Dallas, Morgan, Greene, Stone, Barry, Grundy, Platte, Clay, Jackson, Lafayette, and Cass counties.

Nemophila microcalyx (Nutt.) Fisch. & Mey.

Moist open woods. Circumneutral. Southeastern Mo.: Dunklin and Butler counties.

Ellisia Nyctelea L.

Moist woods, thickets, alluvial soils, and cultivated or waste ground. Circumneutral. General but scattered: Mercer, Schuyler, Shelby, Marion, Randolph, Boone, Cooper, Cole, Lincoln, St. Louis, Jefferson, Franklin, Wayne, Shannon, Phelps, Pulaski, Laclede, Texas, Howell, Saline, Grundy, Daviess, Platte, Clay, Jackson, Cass, Henry, Polk, Greene, Barry, Jasper, and McDonald counties.

Phacelia bipinnatifida Michx.

Rich rocky woods and banks. Circumneutral. Eastern and middle Mo., south of the Missouri River: St. Louis, Jefferson, Crawford, Shannon, Carter, Phelps, Pulaski, and Texas counties.

Phacelia Purshii Buckley. Miami Mist.

Moist open woods, alluvial thickets, and along rocky banks, bluffs, and open places. Circumneutral to calciphile. Eastern and middle Mo. and scattered southwestward, mostly south of the Missouri River: Boone, Callaway, Cole, Montgomery, Warren, Lincoln, St. Louis, Jefferson, Franklin, Washington, St. Francois, Ste. Genevieve, Madison, Bollinger, Iron, Wayne, Reynolds, Carter,

Ripley, Shannon, Gasconade, Maries, Osage, Crawford, Dent, Oregon, Phelps, Pulaski, Ozark, Miller, Camden, Laclede, and Cedar counties, and also introduced in Jackson Co.

Phacelia hirsuta Nutt.

Rocky prairies, glades, ledges along bluffs, low rich woods, and alluvial ground along streams. Calciphile to circumneutral. Southern Mo.: Shannon, Oregon, Douglas, Wright, Webster, Ozark, Greene, Stone, Lawrence, Barry, Jasper, Newton, and McDonald counties. This has frequently been confused with *Phacelia dubia*, an eastern species not known in Missouri.

Hydrolea ovata Nutt.

Swamps and bayous. Circumneutral to oxylophile. Southeastern Mo.: Dunklin and Butler counties.

Hydrolea affinis Gray.

Swampy woods, sloughs, and bayous. Circumneutral to oxylophile. Southeastern Mo.: Cape Girardeau, Bollinger, Stoddard, New Madrid, Dunklin, Butler, and Ripley counties.

Fam. Boraginaceae

Heliotropium tenellum (Nutt.) Torr.

Rocky prairies and glades. Calciphile to circumneutral. Eastern, central, and southern Mo., mostly in the Ozark region: Ralls, Montgomery, St. Charles, St. Louis, Jefferson, Franklin, Washington, St. Francois, Ste. Genevieve, Iron Reynolds, Ripley, Shannon, Dent, Osage, Maries, Phelps, Pulaski, Camden, Laclede, Wright, Douglas, Ozark, Taney, Stone, Greene, Polk, Hickory, Dallas, Barry, Jasper, and McDonald counties.

HELIOTROPIUM INDICUM L. Indian Heliotrope.

Low moist alluvial woods and waste ground. Central and southern Mo.: Lincoln, St. Charles, St. Louis, Jefferson, Perry, Cape Girardeau, Bollinger, Scott, Mississippi, New Madrid, Pemiscot, Dunklin, Butler, Ripley, Oregon, Shannon, Reynolds, Gasconade, Osage, Maries, Jackson, Henry, Greene, Taney, Stone, Barry, and McDonald counties.

CYNOGLOSSUM OFFICINALE L. Hound's Tongue.

Fields and rocky waste ground. Circumneutral to oxylophile. Central and southern Mo.: Ralls, Pike, Lincoln, Warren, St. Louis, Jefferson, Washington, St. Francois, Madison, Dent, Carter, Iron, Reynolds, Shannon, Oregon, Boone, Jackson, Greene, and Taney counties.

Cynoglossum virginianum L. Wild Comfrey.

Rich or rocky woods and alluvial thickets. Circumneutral. Central and southern Mo.: Boone, Cole, Warren, St. Louis, Jefferson, Franklin, Washington, St. Francois, Ste. Genevieve, Cape Girardeau, Bollinger, Madison, Wayne, Iron, Reynolds, Dunklin, Ripley, Oregon, Dent, Osage, Greene, Shannon, and Barry counties.

Lappula virginiana (L.) Greene. Beggar's Lice.

Open woods, thickets, and waste ground. Circumneutral. General.

Lappula Redowskii (Hornem.) Greene var. **occidentalis** (Wats.) Rydb.

Waste ground along railroads. Introduced from farther west. Jackson Co.

LAPPULA ECHINATA Gilib. Stickseed.

Waste and cultivated ground. Indifferent. General but scattered: Marion, St. Louis, St. Francois, Iron, Dent, Atchison, Jackson, and Barry counties.

Amsinckia lycopsoides Lehm.

Introduced along railroads. Jackson Co.

SYMPHYTUM OFFICINALE L. Comfrey.

Waste ground and along railways. Escaped from cultivation. Washington and Jackson counties.

Myosotis virginica (L.) BSP. Scorpion Grass.

Open woods, prairies, and waste ground. Circumneutral. General.

Myosotis virginica var. **macrosperma** (Engelm.) Fernald.

In similar situations to the typical form. Southern Mo., scattered: Dunklin, Shannon, and Jasper counties.

MYOSOTIS SCIRPOIDES L. Forget-me-not.

Shaded ground along spring branch. Introduced in St. Louis Co.

Mertensia virginica L. Bluebells, Virginia Cowslip.

Moist rich woods and slopes, sometimes on low rocky slopes and bluffs, usually in alluvial soils. Circumneutral to calciphile. General: Knox, Adair, Marion, Pike, Audrain, Callaway, Warren, St. Louis, Jefferson, Franklin, St. Francois, Madison, Wayne, Washington, Bollinger, Texas, Pulaski, Miller, Daviess, Sullivan, Grundy, Clay, Jackson, Johnson, Laclede, Greene, Christian, Taney, and Stone counties.

LITHOSPERMUM ARVENSE L. Corn Gromwell.

Fields, waste ground, and along roadsides and railroads. Indifferent. General.

Lithospermum latifolium Michx.

Rich woods and thickets. Circumneutral. Scattered: St. Louis and Jackson counties.

Lithospermum caroliniense (Walt.) MacM. See Rh. **17**: 131. 1915.

Lithospermum Gmelini (Michx.) Hitchc. (G).

Prairies and thickets. Oxylophile. Northern and east-central Mo., scattered: St. Louis, Jefferson, and Nodaway counties.

Lithospermum canescens (Michx.) Lehm. Orange Puccoon.

Rocky open woods, glades, and prairies. Calciphile to circumneutral. General, but commonest in the Ozark region.

Lithospermum angustifolium Michx. Yellow Puccoon.

Dry open woods, glades, and prairies. Calciphile to circumneutral. General but scattered: Clark, Boone, St. Louis, Jefferson, Washington, Iron, Dent, Shannon, Pemiscot, Miller, Camden, Randolph, Atchison, Holt, Buchanan, Clay, Jackson, Cass, Carroll, Pettis, Cedar, Greene, Stone, Vernon, Jasper, and Newton counties.

Onosmodium occidentale Mack. False Gromwell.

Rocky prairies, glades, thickets, and loess hills. Circumneutral. General.

Onosmodium occidentale var. **sylvestre** Mack.

Open woods and thickets. Circumneutral. Scattered: St. Louis and Jackson counties.

Onosmodium hispidissimum Mack.

Dry rocky prairies, thickets, and glades. Circumneutral. Central and western Mo.: St. Louis, Jefferson, Franklin, Randolph, Boone, Holt, Clay, Jackson, and Jasper counties.

Onosmodium hispidissimum var. **macrospermum** Mack. & Bush.

Rich woods and moist prairies. Circumneutral. Western Mo., local: Jackson Co.

Onosmodium subsetosum Mack. & Bush.

Dry rocky prairies, thickets, and glades. Circumneutral to calciphile. Central and southern Mo.: Boone, St. Louis, Jefferson, Washington, St. Francois, Ste. Genevieve, Dent, Shannon, Texas, Phelps, Miller, Camden, Greene, Christian, Douglas, Ozark, Stone, Barry, and Jasper counties.

ECHIUM VULGARE L. Blue-weed.

Waste ground, gravel bars, and roadsides. Calciphile. Scattered: Marion, Ralls, St. Louis, Jefferson, St. Francois, Reynolds, Shannon, Clay, and Jackson counties.

Fam. VERBENACEAE

Verbena urticifolia L. White Vervain.

Fields, roadsides, and waste ground. Indifferent. General.

Verbena simplex Lehm. See Ann. Mo. Bot. Gard. **20**: 282. 1933.

Verbena angustifolia Michx., not Mill. (G), (B & B).

Prairies, fields, and glades. Calciphile to circumneutral. Eastern, central, and southern Mo., south and east of a line drawn from Marion and Boone counties to Jackson Co.

Verbena hastata L. Blue Vervain.

Low open woods, wet prairies, fields, and waste ground. Circumneutral. General, but commonest in northern and central Mo.

Verbena stricta Vent.

Prairies, thickets, glades, and waste ground. Circumneutral. General.

Verbena bracteata Lag. & Rodr. See Ann. Mo. Bot. Gard. **20**: 304. 1933.

Verbena bracteosa Michx. (G), (B & B).

Fields, roadsides, and waste ground. Circumneutral. General.

Verbena bipinnatifida Nutt.

Along railroads and in waste ground. Introduced from farther west. Jackson Co.

Verbena canadensis (L.) Britton. Wild Verbena.

Prairies, fields, glades, and rocky slopes. Calciphile to circumneutral. General, but commonest in central and southern Mo.

Verbena simplex × stricta.

Occasionally found with the parent species. St. Louis, Jefferson, Franklin, Phelps, Greene, Barry, and Jasper counties.

Verbena bracteata × stricta

Occasionally found with the parent species. Jasper Co.

Lippia lanceolata Michx. var. **recognita** Fernald & Griscom, Rh. **37**: 178. 1935. Fog-fruit.

Prairie swales, ditches, and borders of ponds and streams. Circumneutral to calciphile. General. Typical *Lippia lanceolata* is found along the coastal plain and does not reach Missouri.

Lippia nodiflora (L.) Michx.

Low swampy woods. Circumneutral. Southeastern Mo., local: Dunklin Co.

Fam. LABIATAE

Teucrium canadense L. var. **virginicum** (L.) Eat. See Rh. **35**: 395. 1933.

Teucrium canadense of auth., not L. (G), (B & B).

Thickets, fields, and waste ground. Circumneutral. General.

Teucrium occidentale Gray.

Prairies. Circumneutral. Western Mo., local: Jackson Co. Perhaps introduced.

Isanthus brachiatus (L.) BSP. False Pennyroyal.

Rocky banks, prairies, and glades. Circumneutral to calciphile. General but scattered: Clark, Macon, Boone, Montgomery, St. Charles, St. Louis, Crawford, St. Francois, Bollinger, Reynolds, Shannon, Oregon, Texas, Dent, Ozark, Pulaski, Laclede, Dallas, Jackson, Barry, Jasper, Newton, and McDonald counties.

Trichostema dichotomum L. Blue Curls.

Rocky open woods and glades. Oxylophile. Eastern and middle Mo., mostly in the eastern Ozark region: Montgomery, St. Louis, Jefferson, Ste. Genevieve, St. Francois, Iron, Wayne, Dunklin, Reynolds, Crawford, Phelps, Shannon, Texas, and Howell counties.

Scutellaria lateriflora L. Mad-dog Skullcap.

Wet woods and borders of streams. Circumneutral. General but scattered: Marion, Boone, Lincoln, St. Charles, St. Louis, Jefferson, St. Francois, Perry, Bollinger, Mississippi, New Madrid, Pemiscot, Dunklin, Butler, Ripley, Carter, Reynolds, Iron, Pulaski, Oregon, Howell, Dallas, Greene, Taney, Atchison, Buchanan, Clay, Jackson, Cass, Jasper, and McDonald counties.

Scutellaria lateriflora f. **rhodantha** Fernald, Rh. **23**: 86. 1921.

Occasionally found with the common form of the species.

Scutellaria ovata Hill. See Contr. U. S. Nat. Herb. **22**: 734. 1927.

Scutellaria versicolor Nutt. (G).

Scutellaria cordifolia Muhl. (B & B).

Rocky open woods, bluffs, and glades. Calciphile to circumneutral. General.

Scutellaria ovata var. **pilosior** (Benth.) Leonard, Contr. U. S. Nat. Herb. **22**: 735. 1927.

Scutellaria versicolor var. *minor* Chapm.

Rocky bluffs and ledges. Central and southern Mo.: St. Louis, Iron, Maries, Phelps, Pulaski, Laclede, Ozark, Taney, and Barry counties.

Scutellaria ovata var. **bracteata** (Benth.) Blake, Rh. **17**: 134. 1915; also U. S. Nat. Herb. **22**[10]: 735. 1927.

Rocky open or shaded ground. Circumneutral to calciphile. East-central and southern Mo., scattered: St. Louis and Barry counties.

Scutellaria montana Chapm. See Contr. U. S. Nat. Herb. **22**^{10}: 740. 1927.

Rocky open woods. Circumneutral. Southeastern Mo., local: Iron Co. This has been confused with *Scutellaria serrata*, a species not known to occur in Mo.

Scutellaria incana Spreng. See Contr. U. S. Nat. Herb. **22**^{10}: 743. 1927.

Scutellaria canescens Nutt. (G).

Rocky open woods and thickets. Circumneutral. East-central and southern Mo.: Ralls, Pike, Lincoln, Warren, St. Louis, Jefferson, St. Francois, Perry, Cape Girardeau, Iron, Wayne, Bollinger, Butler, Ripley, Oregon, Carter, Reynolds, Shannon, Texas, Dent, Maries, Phelps, Pulaski, Miller, Howell, Douglas, Hickory, Greene, Stone, Jasper, Newton, and McDonald counties.

Scutellaria punctata (Chapm.) Leonard.

Scutellaria canescens var. *punctata* Chapm.

Rocky open woods and thickets. Circumneutral. Southern Mo.: Iron, Reynolds, Texas, Douglas, Howell, and Ozark counties.

Scutellaria ovalifolia Pers. See Contr. U. S. Nat. Herb. **22**^{10}: 741. 1927.

Scutellaria pilosa Michx., not Hill (G), (B & B).

Rocky woods and bluffs. Circumneutral to oxylophile. Southern Mo.: Ste. Genevieve, Iron, Ripley, Wayne, Reynolds, Shannon, Texas, Laclede, Wright, Ozark, Stone, and Barry counties.

Scutellaria epilobifolia Hamilton. See Contr. U. S. Nat. Herb. **22**^{10}: 723–724. 1927; and Rh. **23**: 85. 1921.

Scutellaria galericulata of Am. auth., not L. (G), (B & B).

Low wet woods. Circumneutral. Western Mo., local: Jackson Co.

Scutellaria Bushii Britton.

Glades and bald knobs. Calciphile. Southern Mo.: Carter, Dent, Shannon, Pulaski, Douglas, and Ozark counties.

Scutellaria parvula Michx.

Rocky prairies and glades. Circumneutral. General but commonest in the Ozark region.

Scutellaria parvula var. **ambigua** (Nutt.) Fernald.

Frequently found with the typical form. General but scattered, and commoner in northern and central Mo.

Scutellaria nervosa Pursh.

Rich moist woods and thickets. Circumneutral. Eastern and middle Mo.: Schuyler, Shelby, Boone, Lincoln, St. Charles, St. Louis, Cape Girardeau, Pemiscot, and Dunklin counties.

MARRUBIUM VULGARE L. Horehound.

Fields, roadsides, and waste ground, especially about old dwellings. Indifferent. General and probably in every county.

Agastache nepetoides (L.) Ktze. Giant Hyssop.

Thickets and borders of woods. Circumneutral. General.

Agastache scrophulariaefolia (Willd.) Ktze.

Thickets, open woods, and alluvial ground. Circumneutral. Northern and west-central Mo.: Scotland, Mercer, Jackson, and Cass counties.

Agastache scrophulariaefolia var. **mollis** (Fernald) Heller.

Similar situations to the preceding. Circumneutral. Scattered in northern and west-central Mo.: Scotland and Jackson counties.

NEPETA CATARIA L. Catnip.

Fields, roadsides, and waste ground about old dwellings. Indifferent. General and probably in every county.

NEPETA HEDERACEA (L.) Trevisan. See Rh. **23**: 289. 1921. Ground Ivy, Gill-over-the-ground.

Fields, waste ground, and open banks. Planted in old gardens and freely escaping. Indifferent. Scattered in eastern Mo.: Marion, Pike, and St. Louis counties. The typical form of *Nepeta hederacea* with larger flowers is not as common in Missouri as the next following.

NEPETA HEDERACEA var. PARVIFLORA Benth. See Rh. **23**: 289. 1921.

Similar situations to the preceding, and more common. Indifferent. General.

Dracocephalum parviflorum Nutt. Dragon Head.

Along railroads and in waste ground. Escaped from cultivation. Indifferent. Scattered: St. Louis and Jackson counties.

PRUNELLA VULGARIS L. Self-heal, Heal-all.

Thickets, fields, and waste ground. Circumneutral. General.

Prunella vulgaris var. **lanceolata** (Barton) Fernald, Rh. **15**: 183. 1913.

Low woods, thickets, and along streams. In similar situations to the typical form. General.

Prunella vulgaris var. **lanceolata** f. **iodacalyx** Fernald, Rh. **15**: 184. 1913.

Occasionally found with the typical form. Scattered: Ralls, St. Louis, Franklin, Stone, and Jasper counties.

Physostegia virginiana (L.) Benth. Obedient Plant, False Dragon-head.

Moist ground, along prairie streams, and in glades. Circumneutral. General.

Physostegia intermedia (Nutt.) Engelm. & Gray.

Low wet woods and swamps. Circumneutral. Southeastern Mo.: Dunklin, Butler, and Ripley counties.

Physostegia formosior Lunell, Bull. Leeds Herb. 2: 7. 1908.

Rocky open ground. Circumneutral. Central and southern Mo., scattered: St. Louis, Iron, Jackson, and Cass counties.

LAMIUM AMPLEXICAULE L. Henbit.

Lawns, meadows, and cultivated or waste ground. Indifferent. General.

LAMIUM PURPUREUM L. Dead Nettle.

Roadsides and waste ground. Indifferent. Scattered: St. Charles, St. Louis, Saline, Barry, Jasper, and Jackson counties.

LEONURUS CARDIACA L. Motherwort.

Fields, roadsides, and waste ground about dwellings. Indifferent. General.

Stachys tenuifolia Willd. Hedge Nettle.

Rich woods, thickets, and roadsides. Circumneutral. General.

Stachys aspera Michx.

Low moist ground. Circumneutral. Local: St. Louis Co.

Stachys hispida Pursh.

Stachys tenuifolia Willd. var. *aspera* of auth., not *S. aspera* Michx. (G).

Stachys aspera of auth., not Michx. (B & B).

Low alluvial ground. Circumneutral. Northern, central, and eastern Mo.: Perry, Audrain, Ralls, Sullivan, Worth, Clay, and Jackson counties.

Stachys palustris L.

Thickets and moist ground along prairie streams. Circumneutral. Northern Mo., local: Daviess Co.

Stachys ambigua Sm.

Stachys palustris of auth. in part, not L.

Open or moist ground along streams. Circumneutral. General but scattered: Clark, Scotland, Knox, Adair, St. Charles, St. Louis, New Madrid, Pemiscot, Putnam, Atchison, Holt, Andrew, Ray, and Jackson counties.

Salvia lyrata L. Cancer-weed.

Rich or rocky woods, thickets, and moist open ground. Circumneutral to oxylophile. East-central and southern Mo., commonest in the eastern Ozark region: St. Louis, Jefferson, Washington, St. Francois, Ste. Genevieve, Perry, Bollinger, Madison, Iron, Wayne, Butler, Dunklin, Ripley, Carter, Oregon, Shannon, Texas, Howell, Douglas, Taney, and Barry counties.

Salvia azurea Lam. var. **grandiflora** Benth. Blue Sage.

Rocky prairies, roadsides, and glades. Circumneutral to calciphile. West-central and southwestern Mo.: Jackson, Cass, Johnson, Henry, Greene, Ozark, Taney, Stone, Barry, Barton, Jasper, Newton, and McDonald counties, and also introduced in St. Louis Co.

Salvia lanceaefolia Poir.

Plains, fields, and waste ground. Indifferent. Perhaps native in northwestern Mo., but introduced in most of the state. General but scattered: Monroe, Marion, Montgomery, Warren, St. Charles, St. Louis, Mississippi, Stoddard, Ripley, Texas, Greene, Livingston, Caldwell, Atchison, Holt, Andrew, Gentry, Dekalb, Jackson, Johnson, Jasper, and McDonald counties.

SALVIA SCLAREA L. Clear-eye.

Cultivated and rarely escaped to roadsides and waste ground. St. Louis Co.

Monarda didyma L. Bee Balm.

Moist open woods. Circumneutral. Pike and Clay counties. Probably escaped from cultivation.

Monarda pectinata Nutt.

Along railways and in waste ground. Introduced in Jackson Co.

Monarda fistulosa L. Wild Bergamot.

Rocky prairies, thickets, and roadsides. Circumneutral to calciphile. General but scattered: Schuyler, Scotland, Sullivan, Adair, Marion, Ralls, Randolph, Boone, St. Louis, Jefferson, Ste. Genevieve, St. Francois, Dunklin, Butler, Ripley, Shannon, Maries, Dent, Phelps, Pulaski, Howell, Taney, Barry, Buchanan, Jackson, Barton, Jasper, and McDonald counties.

Monarda fistulosa var. **mollis** (L.) Benth.

Monarda mollis L. (G), (B & B).

Rocky prairies, thickets, and roadsides. Circumneutral. General.

Monarda Bradburiana Beck.

Open rocky woods, thickets, and glades. Circumneutral to calciphile. Eastern, central, and southern Mo., south and east of a line from Marion, Boone, and Benton counties to Jasper Co.

Monarda punctata L. Horse Mint.

Prairies and open ground. Circumneutral to oxylophile. Southeastern Mo., scattered: Scott and Dunklin counties.

Monarda punctata var. **villicaulis** Pennell, Bull. Torr. Bot. Club **46**: 186. 1919.

Sandy open ground. Circumneutral to oxylophile. Eastern Mo., scattered: Clark, Pike, and Dunklin counties.

Monarda punctata var. **occidentalis** (Epling) Palmer & Steyermark, comb. nov.

Monarda punctata subsp. *occidentalis* Epling, Madroño **3**: 25. 1935.

Open ground. Circumneutral. Western Mo., local: Jackson Co.

Monarda citriodora Cerv.

Monarda dispersa Small (B & B).

Rocky prairies, glades, and bald knobs. Calciphile to circumneutral. Central and southwestern Mo.: St. Louis, Boone, Jackson, St. Clair, Greene, Taney, Stone, Barry, Jasper, and McDonald counties.

Blephilia hirsuta (Pursh) Benth. Wood Mint.

Rich open woods and thickets. Circumneutral. General.

Blephilia ciliata (L.) Raf. Ohio Horse Mint.

Open woods and thickets. Circumneutral. General.

Hedeoma pulegioides (L.) Pers. Pennyroyal.

Rocky open woods, thickets, and glades. Circumneutral. General.

Hedeoma hispida Pursh.

Rocky prairies and glades. Circumneutral to oxylophile. General but scattered: Shelby, Boone, Lincoln, St. Louis, Jefferson, Franklin, Washington, St. Francois, Ste. Genevieve, Madison, Iron, Reynolds, Dunklin, Shannon, Dent, Laclede, Wright, Douglas, Webster, St. Clair, Harrison, Platte, Clay, Jackson, Cass, Jasper, and Newton counties.

HEDEOMA ACINIOIDES Scheele.

Waste ground. Introduced in Jasper Co.

Satureja glabra (Nutt.) Fernald. Savory, Calamint.

Rocky open ledges and glades. Calciphile. Central and southern Mo.: St. Louis, Jefferson, St. Francois, Ste. Genevieve, Washington, Iron, Reynolds, Carter, Ripley, Oregon, Shannon, Texas, Phelps, Maries, Pulaski, Miller, Douglas, Wright, Ozark, Taney, Benton, Hickory, St. Clair, Polk, Greene, Stone, Barry, and McDonald counties.

MELISSA OFFICINALIS L. Lemon Balm.

Thickets, roadsides, and waste ground. Indifferent. Central and southern Mo., scattered: Boone, St. Louis, Jefferson, Greene, Stone, Barry, Jackson, Jasper, Newton, and McDonald counties.

Pycnanthemum Torrei Benth.

Dry open ground. Oxylophile. Southeastern Mo.: Dunklin Co.

Pycnanthemum flexuosum (Walt.) BSP. Mountain Mint.

Rocky open woods and thickets. Circumneutral. General and common.

Pycnanthemum pilosum Nutt.

Prairies, thickets, and open woods. Circumneutral. General.

Pycnanthemum virginianum (L.) Durand & Jackson.

Rocky woods, crevices of bluffs, and thickets. Circumneutral to calciphile. Central and southern Mo.: Boone, Audrain, St. Louis, Jefferson, St. Francois, Iron, Butler, Carter, Oregon, Shannon, Texas, Dent, Howell, Saline, Jackson, Benton, Greene, Hickory, Taney, and Stone counties.

Pycnanthemum incanum (L.) Michx.

Rocky open woods. Oxylophile. Southern Mo., scattered: Dunklin, Butler, Ripley, Shannon, and Barry counties.

Pycnanthemum albescens T. & G.

Rocky open woods. Oxylophile. Southern Mo.: Madison, Ste. Genevieve, Perry, Wayne, Dunklin, Butler, Ripley, Dent, Shannon, Phelps, Pulaski, Texas, Howell, Ozark, Douglas, Barry, Newton, and McDonald counties. This has often been confused with the preceding, but is the commoner of the two species.

Pycnanthemum muticum (Michx.) Pers.

Rocky open woods. Circumneutral. Southeastern Mo.: Dunklin and Butler counties.

Cunila origanoides (L.) Britton. Dittany.

Rocky woods. Circumneutral to oxylophile. Central and southern Mo., south and east of a line drawn from Lincoln, Boone, Morgan, and Hickory counties to Jasper Co.

Lycopus virginicus L. Bugle Weed.

Low wet woods and open ground. Circumneutral. General.

Lycopus rubellus Moench. Water Horehound.

Low woods and borders of streams and ponds. Circumneutral. Central and southern Mo.: Boone, St. Louis, Jefferson, Mississippi, Dunklin, Butler, Carter, Shannon, Dent, Texas, Howell, Ozark, Taney, Greene, Barry, Jasper, Newton, and McDonald counties.

Lycopus lucidus Turcz. var. **americanus** Gray.

Lycopus asper Greene (B & B).

Low sandy ground along Missouri River. Oxylophile. West-central Mo., local: Jackson Co.

Lycopus americanus Muhl.

Low wet woods, margins of ponds, and along prairie streams. Circumneutral. General.

MENTHA LONGIFOLIA Huds. See Rh. **26**: 171–175. 1924.

Mentha sylvestris L.

Escaped from cultivation to waste ground and roadsides. Indifferent. Scattered: Clay, Jackson, and Jasper counties.

MENTHA ALOPECUROIDES Hull. Woolly Mint.

Waste ground, fields, and roadsides. Indifferent. Introduced in Jackson Co.

MENTHA CARDIACA Gerarde.

Waste ground and borders of springs and brooks. Indifferent. Introduced in Jasper Co.

MENTHA SPICATA L. Spearmint.

Waste ground and roadsides, especially about dwellings. Indifferent. General, but scattered: Ralls, Boone, Franklin, Jefferson, Dunklin, Dent, Shannon, Phelps, Howell, Cedar, Greene, Stone, Jasper, and Newton counties.

MENTHA PIPERITA L. Peppermint.

Waste ground and margins of springs or spring branches. Circumneutral. General.

MENTHA CITRATA Ehrh. Bergamot Mint.

Waste ground and along spring branches. Introduced in Jasper Co.

MENTHA GENTILIS L.

Waste ground. Indifferent. Introduced in Jackson Co.

Mentha arvensis L.

Low ground along streams. Circumneutral. Southeastern Mo., local: Ripley Co.

Mentha arvensis L. var. **canadensis** (L.) Briq. Corn Mint, Field Mint.

Moist ground along small streams and about springs. Circumneutral. General, but less common than the next. Typical *Mentha arvensis* is rare in Mo.

Mentha arvensis var. **glabrata** (Benth.) Fernald.

In similar situations to the preceding. Circumneutral. General and common. This is the commonest variety found in Missouri.

Collinsonia canadensis L. Horse Balm.

Rich or rocky woods. Circumneutral to oxylophile. Eastern Ozark region: Iron, Wayne, Reynolds, and Shannon counties.

PERILLA FRUTESCENS (L.) Britton. Beef-steak Plant.

Dry woods, rich or alluvial soil along streams, and waste ground. Circumneutral. Escaped and becoming a troublesome weed along some of the Ozark streams. Eastern, central and southern Mo. north to St. Louis, Montgomery, and Jackson counties.

Fam. SOLANACEAE

SOLANUM DULCAMARA L. Climbing Nightshade.

Thickets and roadsides. Indifferent. Scattered: Adair, Boone, St. Louis, Jefferson, Jackson, and Greene counties.

Solanum triflorum Nutt.

Waste ground and along railroads. Introduced from farther west. Jackson Co.

Solanum nigrum L. Black Nightshade.

Waste and cultivated ground. Indifferent. General and common.

Solanum carolinense L. Bull or Horse Nettle.

Rocky prairies, roadsides, and waste ground. Circumneutral. General.

Solanum elaeagnifolium Cav. White Horse Nettle.

Rocky prairies, roadsides, and waste ground. Circumneutral. Central and southern Mo.: St. Louis, Butler, Boone, Saline, Jackson, Barry, Jasper, Newton, and McDonald counties. Perhaps native in southwestern Mo. and introduced in other sections.

Solanum Torreyi Gray.

Rocky open ground and along railroads. Circumneutral to oxylophile. Scattered: St. Louis, Iron, Jackson, and Barry counties. Apparently native in southwestern Mo., and introduced elsewhere.

Solanum rostratum Dunal. Buffalo Bur.

Waste ground and roadsides. Indifferent. General. Introduced from the Southwest and recently spreading over the state.

Physalis ixocarpa Brotero. Tomatillo.

Cultivated and occasionally escaped into waste ground. Jackson Co.

Physalis angulata L.

Cultivated and waste ground, usually on alluvial soil. Circumneutral. Scattered: Pemiscot, St. Louis, Henry, and Jasper counties.

Physalis pendula Rydb.

Alluvial cultivated and waste ground. Circumneutral. Western Mo.: Jackson and Jasper counties.

Physalis pubescens L. Ground Cherry.

Cultivated and waste ground, moist open fields and ledges along streams. Circumneutral. Southern and central Mo., north to St. Louis and Jackson counties.

Physalis pruinosa L. Strawberry Tomato.

Rocky open ground, roadsides, rich alluvial and waste ground. Circumneutral. General but scattered: Marion, Ralls, Boone, St. Louis, Wayne, Shannon, Taney, Jackson, Barry, and Jasper counties.

Physalis barbadensis Jacq.

Moist rocky ground along streams, and ledges along bluffs. Circumneutral. Western and southern Mo.: Ozark, Taney, Jackson, and Jasper counties.

Physalis barbadensis var. **obscura** (Michx.) Rydb.

Rich or rocky woods, bluffs, sandy open ground, and banks along streams. Circumneutral. Central and southern Mo.: St. Louis, New Madrid, Dunklin, Butler, Shannon, Taney, Jackson, and Barry counties.

Physalis missouriensis Mack. & Bush.

Rich woods along bluffs and streams. Circumneutral. Eastern, southern, and central Mo.: Marion, Boone, St. Louis, Jefferson, Shannon, Oregon, Greene, Taney, Barry, Platte, Jackson, Jasper, and McDonald counties. This has been confused with *Physalis Lagascae*, a southern species not found in Mo.

Physalis heterophylla Nees.

Roadsides, fields, and waste ground. Circumneutral. General.

Physalis heterophylla var. **ambigua** (Gray) Rydb.

Occasionally found with the typical form. Adair, St. Louis, Boone, and Webster counties.

Physalis heterophylla var. **nyctaginea** (Dunal) Rydb.

Occasionally found with the typical form. Scattered: Scotland, Cole, Miller, Oregon, Jackson, and Greene counties.

Physalis pumila Nutt.

Dry or rocky open ground, prairies, and glades. Circumneutral. General, but scattered: Macon, St. Louis, Phelps, Barry, Greene, Jackson, Clay, Vernon, and Jasper counties.

Physalis subglabrata Mack. & Bush.

Thickets, prairies, and cultivated and waste ground. Circumneutral. General.

Physalis longifolia Nutt.

Fields and waste ground. Circumneutral. Eastern Mo.: Marion and St. Charles counties.

Physalis virginiana Mill. Ground Cherry.

Dry prairies, rocky open woods, thickets, and waste ground. Circumneutral to oxylophile. General.

Physalis lanceolata Michx.

Prairies and sandy or rocky open ground. Circumneutral. Western Mo., local: Jackson Co.

PHYSALIS PERUVIANA L.

Waste ground. Introduced in St. Louis Co.

LYCOPERSICUM ESCULENTUM Mill. See Rh. **11**: 56. 1909. Tomato.

Cultivated and escaping in many places. Scattered: St. Louis, Dunklin, Boone, Jackson, and Jasper counties. Well established along gravel and sand bars of streams and in other situations in some sections.

NICANDRA PHYSALODES (L.) Pers. Apple-of-Peru.

Physalodes physalodes (L.) Britton (B & B).

Cultivated fields and waste ground. Circumneutral. Scattered: Marion, Boone, St. Louis, Crawford, Phelps, Greene, Stone, Jackson, and Newton counties.

LYCIUM HALIMIFOLIUM Mill. Matrimony Vine.

Waste ground, roadsides, and about old dwellings. Indifferent. General but scattered: Shelby, Marion, Boone, St. Louis, Jefferson, St. Francois, Cole, Atchison, Clay, Jackson, Greene, Jasper, and Newton counties.

DATURA STRAMONIUM L. Jimson Weed.

Cultivated and waste ground. Indifferent. General and common.

DATURA TATULA L. Jimson Weed, Purple Thorn Apple.

Cultivated and waste ground. Indifferent. General.

DATURA METEL L.

Waste ground and roadsides. Indifferent. Scattered: Boone, St. Louis, Phelps, Vernon, and Jasper counties.

NICOTIANA RUSTICA L. Wild Tobacco.

Cultivated and waste ground. Indifferent. St. Louis Co.

NICOTIANA LONGIFOLIA Cav.

Cultivated and escaping into waste ground. Indifferent. St. Louis Co.

Fam. SCROPHULARIACEAE

VERBASCUM THAPSUS L. Mullein.

Pastures, roadsides, and waste ground. Indifferent. General and common.

VERBASCUM BLATTARIA L. Moth Mullein.

Pastures, roadsides, and waste ground. Indifferent. General.

VERBASCUM BLATTARIA f. ALBIFLORUM (G. Don) House, N. Y. Mus. Bull. 243–244: 45. 1923.

Commonly found with the typical form. General.

LINARIA VULGARIS Hill. Butter and Eggs.

Fields, waste ground, and along roadsides and railroads. Oxylophile to circumneutral. General.

Linaria canadensis (L.) Dumont var. **texana** (Scheele) Pennell, Proc. Acad. Nat. Sci. Phila. **73**: 502. 1921. Blue Toadflax.

Rocky prairies, glades, bluffs, and sandy or cherty open ground. Oxylophile. Eastern, central, and southern Mo.: Marion, Lincoln, Montgomery, Warren, St. Charles, St. Louis, Jefferson, Franklin, Ste. Genevieve, St. Francois, Washington, Crawford, Dent, Shannon, Oregon, Iron, Madison, Bollinger, Scott, Mississippi, Dunklin, Butler, Wayne, Jackson, St. Clair, Polk, Greene, Lawrence, Vernon, Jasper, Newton, and McDonald counties. Typical *Linaria canadensis* has a more eastern range and does not extend to Mo.

LINARIA CYMBALARIA (L.) Mill. Kenilworth Ivy.

Waste ground and roadsides. Indifferent. Introduced in Marion and St. Louis counties.

LINARIA SPURIA (L.) Mill. Cancerwort.

Rocky waste ground, and along sand and gravel bars of streams. Scattered: Boone, Barry, and McDonald counties.

KICKXIA ELATINE (L.) Dumort. See Torreya **22**: 81–84. 1922. Cancer-root.

Linaria Elatine (L.) Mill. (G).

Waste ground, and along sand and gravel bars of streams. Oxylophile. Central and southern Mo., scattered: St. Louis, Jefferson, Franklin, Gasconade, Perry, Bollinger, Reynolds, Shannon, Oregon, Texas, Laclede, Douglas, Clay, and Jackson counties.

Collinsia verna Nutt. Blue-eyed-Mary.

Rich woods and thickets. Circumneutral to calciphile. Central and southern Mo., scattered southward: Warren, St. Charles, St. Louis, Jefferson, St. Francois, Scott, Audrain, Callaway, Boone, Cole, Laclede, Montgomery, Howard, Cooper, Saline, Clay, Jackson, Cass, Johnson, Barry, and McDonald counties.

Collinsia violacea Nutt.

Rocky open woods. Circumneutral to oxylophile. Southern Mo.: Jefferson, Dunklin, Benton, Henry, St. Clair, Cedar, Polk, Greene, Bates, Vernon, Jasper, and Newton counties.

Scrophularia marilandica L. Figwort.

Open woods and thickets. Circumneutral. General.

Scrophularia lanceolata Pursh. See Torreya **22**: 81–84. 1922.

Scrophularia leporella Bicknell (G), (B & B).

Open woods and thickets. Circumneutral. Western Mo., local: Jackson Co.

Pentstemon pallidus Small. Beard-tongue.

Pentstemon canescens of auth., not Britton (G), in part.

Prairies, open woods, and bluffs. Oxylophile to circumneutral.

Pentstemon calycosus Small.

Rocky woods and bluffs. Circumneutral. Eastern and southern Mo., scattered: St. Louis and Texas counties.

Pentstemon tubiflorus Nutt.

Prairies and open woods. Oxylophile to circumneutral. General, but commonest in southwestern Mo., and absent from much of the Ozark region and the southeastern lowlands: Putnam, Marion, Shelby, Monroe, Boone, Franklin, Cape Girardeau, Dunklin, Pulaski, Camden, Laclede, Douglas, Wright, Webster, Greene, Taney, Christian, Barry, Hickory, Clay, Jackson, Vernon, Barton, Jasper, Newton, and McDonald counties.

Pentstemon arkansanus Pennell, Proc. Acad. Nat. Sci. Phila. **73**: 493. 1921.

Rocky open woods, bluffs, and glades. Circumneutral to oxylophile. Southern Mo.: Madison, Ozark, Taney, Stone, Barry, Newton, and McDonald counties.

Pentstemon arkansanus var. **pubescens** Pennell, Proc. Acad. Nat. Sci. Phila. **73**: 494. 1921.

Occasionally found with the typical form. Barry Co.

Pentstemon Digitalis (Sweet) Nutt.

Pentstemon laevigatus var. *Digitalis* (Sweet) Gray (G).

Open woods, thickets, prairies, and meadows. Circumneutral. General.

Pentstemon grandiflorus Nutt.

Loess hills and plains. Circumneutral to calciphile. Northwestern Mo.: Atchison Co.

Pentstemon Cobaea Nutt. var. **purpureus** Pennell, Proc. Acad. Nat. Sci. Phila. **73**: 490. 1921.

Glades and bald knobs. Calciphile to circumneutral. Southwestern Mo.: Ozark, Stone, and Taney counties.

Chelone glabra L. Turtlehead.

Wet rocky or boggy ground along small streams and bluffs. Oxylophile. Southeastern and central Mo.: Boone, St. Louis, Jefferson, Franklin, Bollinger, Stoddard, Dunklin, Butler, Clinton, Clay, and Jackson counties.

Chelone obliqua L. var. **speciosa** Pennell & Wherry, Bartonia 10: 19, *pl. 2, fig. 1.* 1929.

Swamps and borders of streams. Oxylophile to circumneutral. Northeastern and central Mo.: Lewis and Chariton counties.

PAULOWNIA TOMENTOSA (Thunb.) Steud. Empress Tree.

Planted and occasionally escaped. Marion, Perry, and Ripley counties.

Mimulus ringens L. Monkey Flower.

Bogs, low woods, and borders of streams, commonest in alluvial soils along the larger rivers. Circumneutral. General.

Mimulus alatus Ait.

Bogs, low woods, and borders of streams. Circumneutral. General. Commoner than the preceding species.

Mimulus glabratus HBK. var. **Fremontii** (Benth.) Grant, Ann. Mo. Bot. Gard. **11**: 190. 1924.

Wet ledges along bluffs, and about springs. Circumneutral to oxylophile. Southern Mo., scattered: Ste. Genevieve, Greene, and Barry counties.

Leucospora multifida (Michx.) Nutt.
Conobea multifida (Michx.) Benth. (G), (B & B).
Low open woods and fields. Circumneutral. Central and southern Mo.

Mecardonia acuminata (Walt.) Small. Water Hyssop.
Bacopa acuminata (Walt.) Robinson (G).
Low wet woods, swamps, and sloughs. Oxylophile to circumneutral. Southern Mo.: Mississippi, Dunklin, Jasper, and Newton counties.

Macuillamia rotundifolia (Michx.) Raf. See Torreya **22**: 79. 1922.
Bacopa rotundifolia (Michx.) Wettst. (G).
Bramia rotundifolia (Michx.) Britton (B & B).
Low wet woods, and borders of ponds, sloughs, and streams. Circumneutral to oxylophile. Central and southern Mo., scattered: Boone, Lincoln, St. Charles, St. Louis, Jefferson, Dent, Maries, Ray, Jackson, Cass, Greene, Jasper, Newton, and McDonald counties.

Ilysanthes dubia (L.) Barnhart. False Pimpernel.
Low wet woods and borders of sloughs and ponds. Circumneutral. General: Putnam, Marion, Boone, Lincoln, St. Charles, St. Louis, Jefferson, Franklin, Ste. Genevieve, Iron, Mississippi, Dunklin, Butler, Harrison, Buchanan, Clay, Jackson, Bates, Vernon, Greene, Taney, Stone, Jasper, and Newton counties.

Ilysanthes inaequalis (Walt.) Pennell, Torreya **19**: 149. 1919.
Ilysanthes anagallidea of auth. in part, not *Gratiola anagallidea* Michx. (G).
Ilysanthes dubia of auth., not *Gratiola dubia* L. (B & B).
Wet ground along streams, and borders of ponds and sloughs. Circumneutral to oxylophile. General but scattered: Linn, Monroe, Ralls, Boone, St. Louis, Ste. Genevieve, St. Francois, Mississippi, Dunklin, Buchanan, Jackson, Henry, Greene, Taney, Barton, Jasper, and Newton counties.

Gratiola lutea Raf. See Rh. **34**: 147. 1932. Clammy Hedge Hyssop.
Gratiola virginiana of auth., not L. (G), (B & B).
Gratiola neglecta Torr.
Low woods and muddy borders of ponds, sloughs, and slow streams. Circumneutral. General.

Gratiola virginiana L. See Rh. **20**: 65. 1918.
Gratiola sphaerocarpa Ell. (G), (B & B).
Muddy borders of ponds, sloughs, and ditches. Circumneutral. General but scattered: Schuyler, Adair, Shelby, Marion, Monroe, Audrain, Boone, Callaway, St. Louis, Washington, Shannon, Dent, Ripley, Texas, Laclede, Howell, Ozark, Wright, Webster, Linn, Livingston, Saline, Jackson, Benton, Greene, Jasper, and Newton counties.

Veronicastrum virginicum (L.) Farwell, Drug. Circ. **61**: 231. 1917. Culver's-root.
Veronica virginica L. (G).
Leptandra virginica (L.) Nutt. (B & B).
Open woods and thickets. Circumneutral. General.

Veronicastrum virginicum f. **villosa** (Raf.) Pennell, Rh. **23**: 6. 1921.
In similar situations to the preceding. Circumneutral. General and commonly occurring with the species.

Veronica serpyllifolia L. Thyme-leaved Speedwell.

Swampy woods and waste ground. Circumneutral to oxylophile. Southeastern Mo.: Cape Girardeau, Bollinger, and Stoddard counties.

Veronica peregrina L. Neckweed.

Cultivated and waste ground. Indifferent. General and common.

Veronica peregrina var. **xalapensis** (HBK.) Pennell, Torreya **19**: 167. 1919.

Occasionally found with the typical form. Waste ground. Indifferent. Scattered: St. Louis and Pemiscot counties.

VERONICA ARVENSIS L. Corn Speedwell.

Cultivated and waste ground, and open rocky woods, glades, and ledges along bluffs. Circumneutral to calciphile. General.

Veronica connata Raf. Water Speedwell.

Veronica Anagallis-aquatica of auth. in part, not L. (G), (B & B).

In and along streams and spring branches. Circumneutral to oxylophile. West-central and southern Mo., scattered: Perry, Bollinger, Reynolds, Ripley, Oregon, Shannon, Dent, Camden, Texas, Howell, Laclede, Dallas, Benton, Douglas, Ozark, Barry, and Jackson counties.

Veronica americana Schwein. American Brooklime.

Wet open ground. Indifferent. Local: Boone Co.

Limosella subulata Ives. See Rh. **20**: 160. 1918; also Torreya **22**: 83–84. 1922. Mudwort.

Limosella aquatica var. *tenuifolia* of auth., not *L. tenuifolia* Wolf (G).

Limosella aquatica of auth., not L. (B & B).

Sand bars of Missouri River. Local: Jackson Co.

Dasistoma macrophylla (Nutt.) Raf. See Rh. **20**: 68. 1918. False Foxglove.

Seymeria macrophylla Nutt. (G).

Afzellia macrophylla (Nutt.) Ktze. (B & B).

Open woods and thickets. Oxylophile. General.

Aureolaria grandiflora (Benth.) Pennell var. **cinerea** Pennell, Proc. Acad. Nat. Sci. Phila. **73**: 510. 1921.

Gerardia grandiflora var. *serrata* (Torr.) Robinson, in part (G).

Dasystoma serrata (Benth.) Small, in part (B & B).

Rocky woods and thickets. Oxylophile. Middle and western Mo., mostly south of the Missouri River: Crawford, Dent, Gasconade, Boone, Moniteau, Miller, Pulaski, Phelps, Benton, Camden, Polk, Greene, Webster, Wright, Douglas, Ozark, Christian, Taney, Stone, Barry, Henry, Cedar, Vernon, Jasper, Newton, and McDonald counties.

Aureolaria grandiflora var. **pulchra** Pennell, Proc. Acad. Nat. Sci. Phila. **80**: 392. 1928.

Rich or rocky open woods. Oxylophile. Northeastern and east-central Mo.: Clark, Knox, Macon, Adair, Schuyler, Sullivan, Shelby, Marion, Ralls, Monroe, Lincoln, St. Charles, St. Louis, Jefferson, Franklin, Crawford, Gasconade, and Maries counties.

Aureolaria pectinata (Nutt.) Pennell, Bull. Torr. Bot. Club **40**: 414. 1913 Yellow False Foxglove.

Gerardia pedicularis var. *pectinata* Nutt., in part (G).

Dasystoma pectinata (Nutt.) Benth., in part (B & B).

Rocky open woods and borders of glades. Oxylophile. East-central and southern Mo.: St. Louis, Jefferson, Franklin, Iron, Madison, Wayne, Oregon, Shannon, Dent, Crawford, Maries, Pulaski, Texas, Wright, Webster, Greene, Howell, Douglas, Ozark, Stone, and Barry counties.

Aureolaria flava (L.) Farwell var. **macrantha** Pennell, Proc. Acad. Nat. Sci. Phila. **73**: 511. 1921.

Gerardia flava L., in part (G).

Dasystoma flava (L.) Wood, in part (B & B).

Rocky woods. Oxylophile. Southern Mo., mainly in the eastern Ozark region: Phelps, Reynolds, Iron, Madison, Wayne, Scott, and Oregon counties.

Aureolaria calycosa (Mack. & Bush) Pennell, Proc. Acad. Nat. Sci. Phila. **73**: 512. 1921.

Dasystoma calycosa Mack. & Bush (B & B).

Rocky open woods and borders of glades. Oxylophile. Southern Mo., mostly in the eastern Ozark region: St. Francois, Madison, Bollinger, Cape Girardeau, Iron, Wayne, Carter, Ripley, Shannon, Oregon, Texas, Howell, Douglas, and Ozark counties.

Otophylla auriculata (Michx.) Small. See Rh. **20**: 137. 1918.

Gerardia auriculata Michx. (G).

Prairies, thickets, and open woods. Circumneutral to oxylophile. General but scattered: Clark, Adair, St. Louis, Shannon, Ozark, Greene, Barton, Jasper, Newton, and McDonald counties.

Agalinis purpurea (L.) Pennell.

Gerardia purpurea L. (G).

Prairie swales and moist open ground along small streams. Circumneutral to oxylophile. Southern and west-central Mo., scattered: Stoddard, Shannon, Jackson, and Greene counties.

Agalinis aspera (Dougl.) Britton.

Gerardia aspera Dougl. (G).

Prairie swales and moist ground along small streams. Circumneutral. Western Mo., and locally eastward in Crawford Co.: Atchison, Holt, Jackson, Jasper, and Crawford counties.

Agalinis fasciculata (Ell.) Raf.

Gerardia fasciculata Ell. (G).

Prairie swales and borders of woods and thickets. Circumneutral. Southwestern Mo.: Bates, Barton, Jasper, and Newton counties.

Agalinis tenuifolia (Vahl) Raf.

Gerardia tenuifolia Vahl (G).

Prairie swales and moist open banks. Circumneutral to oxylophile. Central and southern Mo.: Boone, St. Louis, Jefferson, Franklin, St. Francois, Dent, Shannon, Carter, Oregon, Jackson, Benton, Christian, and Jasper counties.

Agalinis tenuifolia var. **macrophylla** (Benth.) Blake, Rh. **20**: 71. 1918.

Gerardia tenuifolia var. *macrophylla* Benth. (G).

Gerardia Besseyana Britton (B & B).

Prairies and moist open ground. Circumneutral to oxylophile. General. This is the commonest form throughout the state.

Agalinis tenuifolia var. **parviflora** (Nutt.) Pennell, Proc. Acad. Nat. Sci. Phila. **73**: 525. 1921.

Prairie swales and open banks. Circumneutral to oxylophile. Middle and western Mo., scattered: Boone, Jackson, Douglas, Greene, and Jasper counties.

Agalinis Gattingeri Small.

Gerardia tenuifolia of auth., not Vahl (G), in part.

Rocky open woods. Oxylophile. Eastern, central, and southern Mo.: Clark, Boone, Osage, Franklin, Crawford, Madison, Iron, Shannon, Texas, Miller, Ozark, Taney, Greene, Barry, Jasper, Newton, and McDonald counties.

Agalinis Skinneriana (Wood) Britton.

Gerardia Skinneriana Wood (G).

Dry open woods and thickets. Oxylophile. West-central and southern Mo.: Iron, Dunklin, Shannon, Taney, Barry, Jackson, Jasper, Newton, and McDonald counties.

Agalinis viridis (Small) Pennell.

Gerardia viridis Small.

Thickets, open banks, and borders of woods. Oxylophile. Southern Mo., scattered: Shannon, Dunklin, and Jasper counties.

Agalinis heterophylla (Nutt.) Small.

Moist sandy open ground. Oxylophile. Southeastern Mo.: Dunklin Co.

Buchnera americana L. Blue Hearts.

Upland prairies and glades. Circumneutral to oxylophile. East-central and southern Mo.: St. Louis, Jefferson, Iron, Dent, Shannon, Ripley, Howell, Greene, Stone, Barton, Jasper, Newton, and McDonald counties.

Castilleja coccinea (L.) Spreng. Indian Blanket, Painted Cup.

Upland prairies, glades, and moist open woods. Circumneutral. General but uncommon in most sections.

Castilleja coccinea f. **lutescens** Farwell, Am. Midl. Nat. **8**: 276. 1923.

Occasionally found with the typical form. Washington, Camden, Jasper, and Newton counties.

Castilleja sessiliflora Pursh.

Loess hills and plains. Calciphile. Northwestern Mo.: Atchison and Holt counties.

Castilleja purpurea G. Don.

Rocky open ground. Circumneutral. Southwestern Mo., local: Greene Co.

Pedicularis canadensis L. Wood Betony, Lousewort.

Open woods, thickets, and prairies. Circumneutral to oxylophile. General.

Pedicularis lanceolata Michx.

Wet woods and bogs. Oxylophile. Southern Mo., scattered: Iron, Shannon, Morgan, and Greene counties.

Fam. LENTIBULARIACEAE

Utricularia vulgaris L. var. **americana** Gray. Large Bladderwort.

Sloughs, ponds, and sluggish streams. Circumneutral. General but scattered: Putnam, St. Charles, St. Louis, Jefferson, Reynolds, Butler, Dunklin, Oregon,

Platte, Clay, Jackson, Greene, and Jasper counties. This has been confused with *Utricularia minor,* which is not known in Mo.

Utricularia gibba L.

Stagnant water of ponds, lakes, and sloughs. Circumneutral. Central and southern Mo., scattered: Boone, St. Charles, St. Louis, Iron, Reynolds, Dunklin, Oregon, Texas, Greene, Jackson, and Jasper counties. This species has been confused frequently with *Utricularia pumila* Walt. (*U. biflora* Lam.) which is not known to occur in Mo.

Fam. Orobanchaceae

Orobanche uniflora L. Small Cancer-root.

Rocky open woods and fields. Oxylophile. General but scattered: Ralls, Boone, Cole, St. Louis, Jefferson, Franklin, Ste. Genevieve, Iron, Carter, Crawford, Phelps, Maries, Miller, Camden, Greene, Christian, Platte, Jackson, Johnson, Henry, Vernon, Jasper, Barry, and McDonald counties.

Epifagus virginiana (L.) Bart. Beech-drops.

Rich woods, under beech trees. Circumneutral to oxylophile. Crowleys Ridge, southeastern Mo., local: Scott Co.

Fam. Bignoniaceae

Campsis radicans (L.) Seem. Trumpet Creeper, Trumpet-vine.

Tecoma radicans (L.) Juss. (G).

Bignonia radicans L. (B & B).

Open woods, thickets, banks of streams, and along road and railroad embankments. Indifferent. General, but scattered northward. Native in the Ozark region and introduced or escaped in other sections.

Bignonia capreolata L. Cross-vine.

Low alluvial woods and thickets along streams. Circumneutral to oxylophile. Southeastern Mo.: Iron, Bollinger, Cape Girardeau, Mississippi, Pemiscot, Dunklin, Butler, and Ripley counties.

Catalpa speciosa Warder. Catalpa, Cigar Tree.

Low or upland woods, and also introduced along streams and in waste ground. Eastern and southern Mo.: Pike, Iron, Madison, Bollinger, Cape Girardeau, Scott, Mississippi, New Madrid, Stoddard, Pemiscot, Dunklin, Oregon, Howell, Dallas, Greene, Jasper, and Newton counties. Native in southeastern Mo. and escaped from cultivation elsewhere.

Catalpa bignonioides Walt.

Along streams and roadsides and in waste ground. Indifferent. Scattered: St. Louis, Boone, Jackson, Jasper, and Newton counties. Introduced.

Fam. Pedaliaceae

SESAMUM ORIENTALE L. Benne.

Sesamum indicum L.

Sandy open ground. Introduced in Jackson Co.

Fam. MARTYNIACEAE

Martynia louisiana Mill. Devil's-claws, Unicorn Plant.

Pastures, cultivated and waste ground. Calciphile to circumneutral. Scattered: Boone, St. Louis, St. Francois, New Madrid, Dunklin, Ozark, Jackson, Johnson, Dade, and Greene counties.

Fam. ACANTHACEAE

Dianthera americana L. Water Willow.

Borders of shallow streams, sloughs, and ditches. Circumneutral. Central and southern Mo.: Boone, Montgomery, Warren, St. Louis, Jefferson, Franklin, Washington, St. Francois, Ste. Genevieve, Perry, Cape Girardeau, Bollinger, Madison, Iron, Reynolds, Wayne, Carter, Ripley, Oregon, Shannon, Howell, Texas, Dent, Crawford, Gasconade, Osage, Cole, Miller, Maries, Phelps, Pulaski, Laclede, Wright, Webster, Douglas, Ozark, Greene, Christian, Taney, Stone, Morgan, Camden, Miller, Dallas, Hickory, Polk, Barry, Jackson, Jasper, Newton, and McDonald counties.

Dianthera ovata Walt.

Low wet woods and borders of swamps. Circumneutral. Southeastern Mo.: Stoddard, New Madrid, Pemiscot, Dunklin, Butler, and Ripley counties.

Ruellia caroliniensis (Walt.) Steud. See Rh. **17**: 134. 1915. Wild Petunia.

Ruellia ciliosa Pursh (G), (B & B).

Rocky prairies, hillsides, and glades. Oxylophile to circumneutral. General.

Ruellia caroliniensis var. **parviflora** (Nees) Blake, Rh. **17**: 134. 1915.

Ruellia ciliosa var. *parviflora* (Nees) Britton (G).

Ruellia parviflora (Nees) Britton (B & B).

Glades and rocky ledges. Oxylophile. West-central and southern Mo.: Ste. Genevieve, Butler, Clay, Jackson, Jasper, and Newton counties.

Ruellia strepens L.

Rich or rocky open woods and thickets. Circumneutral to calciphile. General.

Ruellia pedunculata Torr.

Rocky open woods and glades. Circumneutral to calciphile. East-central and southern Mo.: St. Louis, Jefferson, Franklin, Ste. Genevieve, Iron, Madison, Dunklin, Butler, Carter, Reynolds, Dent, Oregon, Shannon, Texas, Howell, Phelps, Pulaski, Wright, Webster, Douglas, Ozark, Taney, Stone, Barry, and McDonald counties.

Dicliptera brachiata (Pursh) Spreng. See Rh. **11**: 57. 1909.

Diapedium brachiatum (Pursh) Ktze. (B & B).

Low alluvial woods and thickets. Circumneutral. East-central and southern Mo.: St. Louis, Gasconade, Shannon, Ripley, Ozark, Taney, Stone, Barry, Jasper, Newton, and McDonald counties.

Fam. PHRYMACEAE

Phryma Leptostachya L. Lopseed.

Rocky or alluvial woods and thickets. Circumneutral. General.

Fam. PLANTAGINACEAE

Plantago cordata Lam.

Swampy woods, sloughs, and rocky stream beds. Circumneutral. Northern, central, and southeastern Mo.: Adair, Boone, St. Louis, Jefferson, Dent, Iron, Carter, and Shannon counties.

Plantago major L. Plantain.

Fields, waste ground, and door yards. Indifferent. General, but less common than the next species.

Plantago Rugelii Dcne. Plantain.

Fields, waste ground, and door yards. Indifferent. General and in every county.

PLANTAGO LANCEOLATA L. Rib Grass.

Pastures, roadsides, and waste ground. Indifferent. General. Broad-leaved specimens of this species have sometimes been confused with *Plantago media* which has not been found in Mo.

Plantago Purshii R. & S. Salt-and-pepper Plant.

Loess hills, glades, dry prairies, and waste ground. Circumneutral. Central and northwestern Mo.: St. Louis, Holt, Clay, and Jackson counties. Probably native in northwestern Mo. and introduced elsewhere.

Plantago spinulosa Dcne.

Waste ground. Indifferent. Introduced in Jackson Co.

Plantago aristata Michx.

Fields, glades, barrens, and waste ground. Oxylophile to circumneutral. General.

Plantago virginica L.

Fields, glades, and rocky waste ground. Oxylophile to circumneutral. General.

Plantago rhodosperma Dcne.

Waste ground. Indifferent. Introduced in Jackson Co.

Plantago heterophylla Nutt.

Sandy open ground. Oxylophile. Southeastern Mo.: Scott Co.

Plantago elongata Pursh.

Plantago pusilla Nutt. (B & B).

Fallow fields, prairies, and glades. Oxylophile to circumneutral. General but most abundant southward: Boone, Audrain, Marion, Lincoln, Montgomery, St. Louis, Jefferson, Franklin, Ste. Genevieve, Iron, Madison, Cape Girardeau, Dunklin, Butler, Wayne, Ripley, Carter, Shannon, Texas, Phelps, Laclede, Greene, Taney, Jackson, Lawrence, Jasper, and Newton counties.

Fam. RUBIACEAE

Galium virgatum Nutt.

Rocky ledges, glades, and prairies. Calciphile to circumneutral. Central and southern Mo.: St. Louis, Jefferson, Franklin, Washington, Ste. Genevieve, Ripley, Oregon, Gasconade, Shannon, Texas, Laclede, Dallas, Miller, Camden, Benton, Hickory, Polk, St. Clair, Greene, Webster, Ozark, Taney, Stone, Barry, Jasper, Newton, and McDonald counties.

Galium Aparine L. Cleavers, Goose Grass.
Rich woods, thickets, alluvial and waste ground. Circumneutral. General.

Galium Aparine var. **Vaillantii** (DC.) Koch.
In similar situations to the typical form. Jackson and Jasper counties.

Galium pilosum Ait.
Rocky woods and thickets. Circumneutral to oxylophile. Central and southern Mo.

Galium pilosum var. **puncticulosum** (Michx.) T. & G.
Occasionally found with the typical form. Southern Mo., scattered: Jefferson and Jasper counties.

Galium circaezans Michx. Wild Licorice.
Rocky woods and thickets. Circumneutral. General.

Galium arkansanum Gray.
Rocky woods. Oxylophile to circumneutral. Southern Mo.: Washington, Ste. Genevieve, Scott, Iron, Reynolds, Carter, Ripley, Dent, Shannon, Oregon, Howell, Texas, Wright, Douglas, Ozark, Taney, Greene, Stone, Barry, Newton, and McDonald counties.

Galium boreale L. var. **hyssopifolium** (Hoffm.) DC. See Rh. **30**: 106–107. 1928. Northern Bedstraw.
Ledges along high north-facing sandstone and dolomite bluffs. Oxylophile to circumneutral. Southeastern Mo., local: Shannon Co.

Galium tinctorium L. Wild Madder.
Swamps and low wet woods and thickets. Circumneutral. General.

Galium Claytoni Michx.
Swampy places and wet ground among hummocks in sink-hole ponds. Circumneutral. Southeastern Mo.: Mississippi, Dent, and Texas counties.

Galium concinnum T. & G. Shining Bedstraw.
Prairie swales and moist open woods. Circumneutral. General.

Galium triflorum Michx. Fragrant Bedstraw.
Rich or moist woods and low open ground. Circumneutral. General.

Spermacoce glabra Michx. Smooth Button-weed.
Low wet woods, fields, and borders of ponds, sloughs, and streams. Circumneutral to oxylophile. Central and southern Mo.: Lincoln, St. Charles, St. Louis, Jefferson, Perry, Mississippi, New Madrid, Pemiscot, Dunklin, Butler, Ripley, Reynolds, Oregon, Howell, Gasconade, Maries, Miller, Pulaski, Laclede, Dallas, Henry, Greene, Taney, Barry, Jasper, Newton, and McDonald counties.

Diodia teres Walt. Rough Button-weed.
Prairies, glades, fields, and waste ground. Oxylophile to circumneutral. General but commonest south of the Missouri River.

Diodia virginiana L. Button-weed.
Low wet woods and borders of streams and bayous. Circumneutral to oxylophile. Southeastern Mo.: Bollinger, Mississippi, New Madrid, Pemiscot, Dunklin, Stoddard, Wayne, Butler, and Ripley counties.

Mitchella repens L. Partridge Berry.
Moist sandy banks of streams, sandy bogs, and moist ledges of sandstone

bluffs. Oxylophile. Eastern Mo., mostly south of the Missouri River: Lincoln, Jefferson, Ste. Genevieve, Perry, Madison, New Madrid, Dunklin, Butler, and Ripley counties.

Cephalanthus occidentalis L. Button-bush.

Low swampy woods and borders of streams and sloughs. Circumneutral. General and probably in every county.

Cephalanthus occidentalis var. **pubescens** Raf.

Swampy woods and borders of bayous. Circumneutral. Southeastern Mo.: Scott, Dunklin, Butler, and Ripley counties.

Houstonia caerulea L. Bluets, Innocence.

Moist open woods, open banks, and moist sandstone or granitic ledges. Oxylophile. Southeastern Mo., mostly in the Iron Mountain sub-region: Ste. Genevieve, St. Francois, Iron, Madison, Wayne, Butler, Dunklin, Ripley, Carter, Shannon, Dent, and Texas counties.

Houstonia patens Ell. Star Violet.

Dry open ground, glades, and rocky ledges, usually in sandstone or granitic areas. Oxylophile. Eastern and middle Mo., mostly south of the Missouri River: Lincoln, Warren, Jefferson, Franklin, Crawford, Ste. Genevieve, St. Francois, Iron, Madison, Wayne, Butler, Dunklin, Ripley. Carter, Reynolds, Gasconade, Dent, Phelps, Dallas, Douglas, and Wright counties.

Houstonia minima Beck. Small Bluets.

Prairies, pastures, glades, rocky ledges, and open soils. Oxylophile to circumneutral. Central and southern Mo. south of a line from Lincoln, Audrain, Randolph, Livingston and Clay counties to Jackson Co.

Houstonia purpurea L.

Moist open woods and ledges along bluffs. Oxylophile. Southwestern Mo.: Webster, Ozark, Greene, Stone, Bates, Vernon, Barton, Jasper, and McDonald counties.

Houstonia tenuifolia Nutt.

Rocky open woods and glades. Oxylophile. Southeastern Mo., local: Madison Co.

Houstonia longifolia Gaertn.

Rocky open woods, glades, and ledges along bluffs. Circumneutral. East-central and southern Mo., south and east of a line drawn from St. Charles, Maries, and Camden counties to Newton Co. This has been confused with *H. ciliolata* which does not occur in Missouri.

Houstonia lanceolata (Poir.) Britton.

Rocky open woods. Oxylophile to circumneutral. East-central and southern Mo., scattered: St. Louis, Jefferson, Taney, and Barry counties.

Houstonia angustifolia Michx.

Rocky ledges, glades, bluffs, and loess hills. Circumneutral to calciphile. Central, southern, and northwestern Mo.: Macon, Howard, Boone, Montgomery, Warren, St. Charles, St. Louis, Jefferson, Franklin, Washington, St. Francois, Ste. Genevieve, Perry, Cape Girardeau, Bollinger, Madison, Dunklin, Iron, Reynolds, Wayne, Carter, Ripley, Oregon, Howell, Shannon, Texas, Dent, Crawford, Phelps, Gasconade, Osage, Maries, Cole, Pulaski, Miller, Morgan, Benton,

Henry, Camden, Laclede, Dallas, Hickory, Polk, Greene, Douglas, Wright, Webster, Ozark, Taney, Stone, Barry, Cedar, Atchison, Holt, Buchanan, Bates, Jasper, Newton, Christian, and McDonald counties.

Oldenlandia uniflora L.

Moist sandy ground. Oxylophile. Southeastern Mo., local: Dunklin Co.

Fam. Caprifoliaceae

LONICERA JAPONICA Thunb. Japanese Honeysuckle.

Open woods, thickets, and roadsides. Escaped from cultivation; scattered but becoming more widespread: Boone, Pike, St. Charles, St. Louis, Cape Girardeau, Bollinger, Scott, Mississippi, Dunklin, Butler, Shannon, Jackson, Vernon, Barton, and Jasper counties.

Lonicera sempervirens L. Trumpet Honeysuckle.

Thickets and roadsides. Escaped from cultivation in our area. Scattered: St. Louis, Greene, Barton, and Jasper counties.

Lonicera prolifera (Kirch.) Rehder, Rh. **12**: 166. 1910. Grape Honeysuckle.

Lonicera Sullivantii Gray (G), (B & B).

Thickets and wooded bluffs. Calciphile. Northern, central, and western Mo.: Mercer, Sullivan, Schuyler, Adair, Clark, Knox, Shelby, Warren, Boone, Saline, Pettis, Benton, Morgan, Clay, Jackson, Cass, Dade, Lawrence, Greene, and Jasper counties.

Lonicera dioica L. var. **glaucescens** (Rydb.) Butters, Minn. Trees & Shrubs. 289. 1912.

Lonicera glaucescens Rydb. (G), (B & B).

Thickets, bluffs, and banks of streams. Circumneutral to calciphile. Northern Mo., south locally in Morgan Co.: Clark, Lewis, Ralls, Atchison, and Morgan counties.

Lonicera flava Sims. Yellow Honeysuckle.

Rocky woods and bluffs. Oxylophile to circumneutral. Southern Mo.: Madison, Iron, Wayne, Reynolds, Carter, Ripley, Shannon, Oregon, Gasconade, Maries, Crawford, Dent, Texas, Howell, Phelps, Pulaski, Camden, Laclede, Dallas, Miller, Hickory, Webster, Wright, Douglas, Ozark, Taney, Stone, Barry, and McDonald counties.

Lonicera flavida Cockerell, Rh. **12**: 167. 1910.

Bluffs and rocky ground along streams. Calciphile to circumneutral. Southwestern Mo.: Greene, Taney, Stone, and Barry counties.

Symphoricarpos orbiculatus Moench. Buck Brush, Indian Currant.

Thickets, rocky bluffs, and banks of streams. Circumneutral to oxylophile. General and probably in every county.

Symphoricarpos occidentalis Hook. Wolfberry.

Loess hills, thickets, and open banks. Calciphile. Northern and west-central Mo.: Adair, Nodaway, Atchison, and Jackson counties.

Triosteum perfoliatum L. Horse Gentian.

Open woods and thickets. Circumneutral. General.

Triosteum aurantiacum Bicknell var. **illinoense** (Wieg.) Palmer & Steyermark, comb. nov.

Triosteum illinoense (Wiegand) Rydb. (R).

Triosteum perfoliatum var. *illinoense* Wiegand.

Rich or rocky woods and bluffs. Circumneutral. Eastern and middle Mo.: Putnam, Schuyler, Sullivan, Adair, Monroe, Audrain, Boone, Warren, Carter, Crawford, Texas, Pulaski, Shannon, Morgan, and Dallas counties.

Triosteum angustifolium L.

Rocky open woods and ledges. Circumneutral to calciphile. Central and southern Mo.: St. Louis, Jefferson, Franklin, Carter, Ripley, Dent, Shannon, Howell, Texas, Morgan, Polk, Wright, Hickory, Webster, Douglas, Greene, Stone, and McDonald counties.

Viburnum molle L. Arrow-wood.

Woods along streams and at base of high bluffs. Calciphile. Central and southern Mo., scattered: Warren, Crawford, Texas, Howell, Benton, Christian, and Stone counties.

Viburnum molle f. **leiophyllum** Rehder, Jour. Arnold Arb. **5**: 57. 1924.

In similar situations to the typical form. Western Mo., south of the Missouri River, scattered: Benton, Taney, Stone, and McDonald counties.

Viburnum pubescens (Ait.) Pursh var. **Deamii** Rehder; Jour. Arnold Arb. **5**: 58. 1924.

Low woods along river. Circumneutral. Northeastern Mo., local: Shelby Co.

Viburnum affine Bush ex Rehder. See Rh. **20**: 14. 1918.

Viburnum pubescens of auth., not Pursh (G), (B & B).

Rocky or open woods and bluffs. Circumneutral to calciphile. General but scattered: Mercer, Sullivan, Schuyler, Clark, Shelby, Adair, Boone, Phelps, Carter, Oregon, Shannon, Howell, Benton, Taney, Stone, Barry, and McDonald counties.

Viburnum affine var. **hypomalacum** Blake, Rh. **20**: 14. 1918.

In similar situations to the typical form. Circumneutral to calciphile. Northeastern and central Mo.: Clark, Lewis, and Morgan counties.

Viburnum prunifolium L. Black Haw.

Woods, thickets, and banks of streams. Circumneutral. General and probably in every county.

Viburnum prunifolium var. **Bushii** (Ashe) Palmer & Steyermark, comb. nov.

Viburnum Bushii Ashe, Jour. Elisha Mitchell Sci. Soc. **40**: 48. 1924.

Rocky or open woods and thickets. Circumneutral. Central and southern Mo.: Cape Girardeau, Washington, Crawford, Iron, Reynolds, Carter, Ripley, Shannon, Texas, Dent, Phelps, Laclede, Camden, Boone, Randolph, Cooper, Moniteau, Saline, Lafayette, Clay, Jackson, Henry, Hickory, Polk, Cedar, Lawrence, Barton, and Jasper counties. This has sometimes been confused with *V. Lentago*.

Viburnum rufidulum Raf. Black Haw.

Rocky woods, thickets, glades, and banks of streams. Circumneutral to calciphile. Central and southern Mo.: Common south of the Missouri River, and north to Ralls, Monroe, and Clay counties.

Viburnum Lentago L. Nannyberry.

Woods and bluffs. Circumneutral. Northeastern Mo., local: Schuyler Co.

Sambucus canadensis L. Elderberry.

Open woods and thickets. Circumneutral. General and probably in every county.

Sambucus canadensis var. **submollis** Rehder in Sarg. Trees & Shrubs **2**: 188. 1911.

In similar situations to the typical form. Circumneutral. General but scattered: Clark, St. Louis, Stoddard, Ripley, Howell, Grundy, Atchison, Jackson, Jasper, Newton, and Barry counties.

Sambucus pubens Michx. Red Elderberry.

Sambucus racemosa of auth., not L. (G), (B & B).

Rich thickets and rocky banks of streams. Circumneutral. Northeastern Mo., local: Marion Co.

Fam. VALERIANACEAE

Valerianella radiata (L.) Dufr. Beaked Corn Salad.

Prairies, fields, and roadsides. Circumneutral. General.

Valerianella radiata var. **leiocarpa** (T. & G.) Krok.

Fields, glades, and rocky open or waste ground. Frequently found with the typical form. General but scattered: Marion, Lincoln, St. Louis, Jefferson, Franklin, Ste. Genevieve, Iron, Wayne, Jackson, Henry, and Jasper counties.

Valerianella stenocarpa (Engelm.) Krok.

Rocky prairies and glades. Circumneutral. Scattered: Pike, Jackson, and Jasper counties.

Valerianella longiflora (T. & G.) Walp.

Rocky open woods and glades. Circumneutral to oxylophile. Southern Mo.: Madison, Taney, Stone, Barry, and McDonald counties.

Fam. DIPSACACEAE

DIPSACUS SYLVESTRIS Huds. Teasel.

Along roadsides, railroads, and gravel bars of small streams. Indifferent. Central and southern Mo.: Boone, Montgomery, Warren, St. Louis, Jefferson, Franklin, Osage, Clay, Webster, Greene, Barry, Jasper, and Newton counties.

Fam. CUCURBITACEAE

Cucurbita foetidissima HBK. Wild Gourd, Missouri Gourd.

Fields, waste ground, and along railroad and road embankments. Circumneutral to calciphile. Central and southern Mo., scattered: St. Louis, Jefferson, Crawford, Boone, Jackson, and Greene counties.

Cayaponia grandifolia (T. & G.) Small.

Low woods and borders of bayous. Circumneutral. Southeastern Mo.: Mississippi and New Madrid counties.

Sicyos angulatus L. One-seeded Bur Cucumber.

Low alluvial woods, rich ground at base of bluffs, fields, thickets, and waste ground. Circumneutral to calciphile. Eastern, southern, and central Mo.:

Marion, Boone, Warren, St. Louis, Jefferson, Franklin, Bollinger, Crawford, Dent, Phelps, Pulaski, St. Francois, Mississippi, Reynolds, Texas, Laclede, Clay, Jackson, Johnson, Hickory, Webster, Jasper, and McDonald counties.

Echinocystis lobata (Michx.) T. & G. Wild Balsam-apple, Wild Cucumber Vine.

Thickets, roadsides, alluvial and waste ground. Circumneutral. General but scattered: Sullivan, Shelby, Boone, St. Charles, St. Louis, Harrison, Gentry, Dekalb, Jackson, Cass, Johnson, Greene, and Jasper counties.

Melothria pendula L.

Rich woods and thickets. Circumneutral. Southern Mo.: Stoddard, Dunklin, Butler, Barry, and McDonald counties.

The watermelon (*Citrullus vulgaris* Schrad.), muskmelon (*Cucumis Melo* L.), cucumber (*Cucumis sativus* L.), pumpkin (*Cucurbita Pepo* L.), and the gourd (*Lagenaria vulgaris* Ser.), are often found growing spontaneously on dumps, waste ground, and along roadsides; but since none of them show any tendency to self-seed or persist they cannot properly be considered as additions to the state flora.

Fam. Campanulaceae

Specularia perfoliata (L.) A. DC. Venus's Looking-glass.

Prairies, fields, and waste ground. Circumneutral. General.

Specularia biflora (R. & S.) Fisch. & Mey.

Fields, roadsides, and waste ground. Circumneutral. Southern Mo.: Bollinger, Dunklin, Ripley, Oregon, Iron, Dent, Wayne, Shannon, Texas, Laclede, Ozark, Christian, Taney, Barry, Jasper, and Newton counties.

Specularia leptocarpa (Nutt.) Gray.

Rocky or gravelly open ground and glades. Circumneutral to oxylophile. Central and southwestern Mo.: St. Louis, Boone, Benton, Jackson, Cass, St. Clair, Jasper, and Newton counties.

Campanula americana L. Tall Bellflower.

Thickets and borders of woods. Circumneutral. General.

Campanula rotundifolia L. Bluebell, Harebell.

Moist ledges along bluffs. Circumneutral to calciphile. Southeastern Mo., local: Shannon Co.

CAMPANULA RAPUNCULOIDES L. Creeping Bellflower.

Fields and waste ground. Introduced in Warren Co.

Fam. Lobeliaceae

Lobelia cardinalis L. Cardinal Flower.

Low wet woods, and borders of sloughs and streams. Circumneutral. General.

Lobelia siphilitica L. Blue Lobelia.

Wet ledges along bluffs, and borders of ponds, sloughs, and small streams. Circumneutral. General.

Lobelia puberula Michx.

Moist sandy open ground and open woods. Oxylophile. Southeastern Mo.: Dunklin and Ripley counties.

Lobelia leptostachys A. DC.

Open woods, glades, and prairies. Circumneutral. Central and southern Mo.: Cole, Warren, St. Louis, Jefferson, Franklin, Washington, Crawford, Madison, Iron, Shannon, Dent, Phelps, Pulaski, Miller, Wright, Ozark, Polk, Hickory, Greene, Taney, Barry, Jackson, Jasper, Newton, and McDonald counties.

Lobelia spicata Lam.

Open woods and prairies. Circumneutral. General: Schuyler, Adair, Macon, Linn, Knox, Shelby, Marion, Montgomery, Boone, Callaway, St. Charles, St. Louis, Reynolds, Oregon, Texas, Polk, Saline, Jackson, Bates, Vernon, and Jasper counties.

Lobelia spicata var. **hirtella** Gray.

Prairies and glades. Circumneutral. Western Mo.: Nodaway, Jackson, Bates, Greene, Jasper, and Newton counties.

Lobelia inflata L. Indian Tobacco.

Rocky open woods, thickets, and alluvial ground along streams. Circumneutral. General.

Fam. COMPOSITAE

Vernonia crinita Raf. Ironweed.

Open woods, thickets, borders of sloughs, and gravel and sand bars along Ozark streams. Circumneutral to oxylophile. Central and southern Mo. south of a line from St. Louis, Warren, Montgomery, Boone, and Pettis counties to Clay Co.

Vernonia fasciculata Michx.

Prairies, meadows, alluvial soils along streams, and waste places in rich moist soil. Circumneutral. General, commonest in northern and central Mo., and apparently absent from most of the Ozark region: Clark, Lewis, Marion, Pike, Lincoln, St. Charles, St. Louis, Butler, Shannon, Boone, Sullivan, Linn, Livingston, Gentry, Nodaway, Holt, Andrew, Buchanan, Platte, Jackson, Cass, Johnson, Henry, and Jasper counties.

Vernonia altissima Nutt.

Thickets, prairies, meadows, and waste ground, common in alluvial and low woods. Circumneutral. General, but commonest in eastern, southern, and central Mo.

Vernonia altissima var. **taeniotricha** Blake, Rh. **19**: 167. 1917.

In similar situations to the typical form. General.

Vernonia missurica Raf.

Vernonia illinoensis Gleason. (G).

Meadows, prairies, moist open ground along streams, fields and waste places. Circumneutral. General, but commonest in northern, central, and western Mo.

Vernonia Baldwini Torr.

Vernonia Baldwini var. *parthenoides* (Daniels) Rickett, Univ. Mo. Stud. Sci. Ser. **6**: 81. 1931.

Fields, prairies, meadows, and waste ground. Circumneutral. Eastern, southern, and central Mo. south and east of a line drawn from Marion, Boone, and Saline counties to Jackson Co.

Vernonia interior Small.

Dry prairies, pastures, and waste ground. Circumneutral. General.

Vernonia interior var. **Drummondii** (Shuttlw.) Mack. & Bush.

Prairies and rocky open ground. Circumneutral. Scattered: St. Francois and Jackson counties.

Vernonia Baldwini × crinita.

Commonly found with the parent species. Rocky woods and glades and along streams. Calciphile to circumneutral. Central and southern Mo.: Jefferson, Washington, Crawford, Reynolds, Ripley, Dent, Shannon, Howell, Oregon, Gasconade, Texas, Dallas, Webster, Polk, Pettis, Stone, Clay, and Jasper counties.

Vernonia altissima × missurica.

Occasionally found with the parent species. Scattered: Gentry, Dekalb, Boone, Crawford, Ripley, and Laclede counties.

Vernonia crinita × fasciculata.

Rarely found with the parent species. St. Louis Co.

Vernonia crinita × interior.

Rarely found with the parent species. Phelps Co.

Vernonia crinita × missurica.

Occasionally found with the parent species. Crawford and Dent counties.

Vernonia fasciculata × interior.

Occasionally found with the parent species. Northwestern Mo.: Buchanan and Andrew counties.

Vernonia interior × missurica.

Sometimes found with the parent species. Clark, St. Louis, and Crawford counties.

Vernonia altissima × crinita.

Rarely found with the parent species. Crawford, Cedar, and Hickory counties.

Elephantopus carolinianus Willd. Elephant's-foot.

Open woods and thickets. Circumneutral. General.

Eupatorium falcatum Michx. See Rh. **22**: 62–68. 1920.

Eupatorium purpureum of auth. in part, not L. (G), (B & B).

Eupatorium Holzingeri Rydb. (R).

Moist ground, thickets, and margins of streams and sloughs. Circumneutral. General and common. This has been confused with *E. maculatum*, which is of more northern range and does not reach Mo.

Eupatorium purpureum L. See Rh. **22**: 62–67. 1920.

Low open woods and moist open ground. Circumneutral. Northern and eastern Mo.: Livingston, Marion, Butler, and Scott counties.

Eupatorium cuneifolium Willd. var. **semiserratum** (DC.) Fernald & Griscom, Rh. **37**: 179. 1935.

Eupatorium semiserratum DC. (G).

Swamps, wet prairies, and open woods. Circumneutral. Southeastern Mo.: Dunklin and Butler counties, and also collected in St. Louis Co. where perhaps introduced.

Eupatorium serotinum Michx.

Prairies, fields, thickets, and waste ground. Circumneutral. General.

Eupatorium sessilifolium L. Upland Boneset.

Rocky open woods, bluffs, and banks. Circumneutral to calciphile. Eastern, central, and southern Mo.: Marion, Ralls, Boone, Jefferson, St. Francois, Iron, Reynolds, Crawford, Shannon, Texas, Pulaski, Camden, Laclede, Greene, Taney, Barry, and McDonald counties.

Eupatorium altissimum L.

Prairies, rocky hills, and thickets. Circumneutral. General.

Eupatorium perfoliatum L. Boneset, Thoroughwort.

Low wet woods, and along sloughs and prairie streams. Oxylophile. General.

Eupatorium perfoliatum var. **cuneatum** Engelm.

Occasionally found with the typical form. Scattered: Marion, Ralls, St. Louis, Perry, Jackson, and Greene counties.

Eupatorium urticaefolium Reichard. White Snakeroot.

Rich woods, thickets, and along base of bluffs. Circumneutral. General.

Eupatorium urticaefolium var. **villicaule** Fernald.

Occasionally found with the typical form. Scattered: Putnam, Boone, St. Louis, Jefferson, Oregon, Ozark, Greene, Christian, Lafayette, and Clinton counties.

Eupatorium incarnatum Walt.

Low woods and swamps. Circumneutral. Southeastern Mo.: Dunklin Co.

Eupatorium coelestinum L. Mist-flower.

Swampy woods, and wet banks of streams and bayous. Circumneutral. Eastern, central, and southern Mo., south and east of a line from Shelby, Boone, and Saline counties to Jackson Co.

Mikania scandens (L.) Willd. Climbing Hemp-weed.

Swampy woods and borders of bayous. Circumneutral. Southeastern Mo.: Scott, Mississippi, New Madrid, Stoddard, Dunklin, and Butler counties.

Brickellia grandiflora (Hook.) Nutt. Tassel Flower.

Rocky woods and along shaded bluffs. Calciphile to circumneutral. Central and southern Mo.: St. Louis, Reynolds, Shannon, Texas, Osage, Phelps, Pulaski, Miller, Camden, Ozark, Taney, Stone, Henry, and Barry counties.

Kuhnia eupatorioides L. False Boneset.

Rocky open woods, prairies, and thickets. Circumneutral to oxylophile. General.

Kuhnia eupatorioides var. **corymbulosa** T. & G.

Occasionally found with the typical form. Scattered: Carroll, Boone, Scott, Atchison, Holt, Jackson, Henry, and Greene counties.

Kuhnia eupatorioides var. **angustifolia** Raf.

Rocky ledges and glades. Circumneutral to oxylophile. Central and southern Mo.: St. Francois, Dent, Shannon, Oregon, Phelps, Maries, Pulaski, Laclede, Greene, Shannon, Texas, Ozark, Barry, Jackson, Jasper, and McDonald counties.

Liatris squarrosa Willd. Blazing Star.

Liatris hirsuta Rydb. (R).

Rocky open woods and glades, and ledges along bluffs. Oxylophile to circumneutral. General, but commonest in the Ozark region: Mercer, Linn, Adair, Macon, Randolph, Boone, Monroe, Audrain, Pike, Montgomery, Lincoln, St. Louis, Stoddard, Iron, Reynolds, Shannon, Dent, Crawford, Phelps, Pulaski, Laclede, Dallas, Saline, Pettis, Henry, Hickory, Greene, Christian, Stone, Barry, Jackson, Cass, Vernon, Jasper, Newton, and McDonald counties.

Liatris squarrosa var. **intermedia** (Lindl.) DC.

Liatris glabrata Rydb., in part (R).

Rocky prairies and glades. Oxylophile to circumneutral. Eastern, central, and southern Mo.: Macon, Boone, St. Louis, Crawford, Dunklin, Iron, Shannon, Dent, Texas, Greene, Christian, Stone, Taney, Jackson, Barry, and McDonald counties.

Liatris cylindracea Michx.

Liatris glabrata Rydb., in part (R).

Rocky open woods, prairies, and glades. Circumneutral. Eastern, central, and southern Mo.: Lewis, Pike, Warren, Montgomery, St. Louis, Jefferson, Franklin, Washington, Ste. Genevieve, Reynolds, Carter, Shannon, Oregon, Dent, Crawford, Maries, Phelps, Pulaski, Texas, Howell, Wright, Douglas, Ozark, Taney, Greene, Stone, Barry, and McDonald counties.

Liatris acidota Engelm. & Gray.

Liatris punctata of auth., not Hook. (G), (B & B).

Lacinaria angustifolia Bush.

Loess hills, prairies, glades, and open woods. Circumneutral to calciphile. Western Mo.: Atchison, Holt, Jackson, Barry, and Taney counties.

Liatris scariosa Willd. Gay Feather.

Liatris sphaeroidea Michx. (R).

Liatris aspera (Michx.) Greene (R).

Rocky prairies, meadows, glades, and bald knobs. Calciphile to circumneutral. General.

Liatris pycnostachya Michx.

Prairies, meadows, and rocky open ground. Circumneutral. General.

Liatris spicata (L.) Willd.

Rocky open woods and prairies. Circumneutral. Southeastern Mo., local: Oregon Co.

Grindelia squarrosa (Pursh) Dunal. Gum Plant.

Prairies, low alluvial and waste ground. Calciphile to circumneutral. Eastern and central Mo., scattered: Marion, St. Louis, Perry, Carroll, and Jackson counties.

Grindelia squarrosa var. **serrulata** (Rydb.) Steyermark, Ann. Mo. Bot. Gard. **21**: 227, 482. 1934.

Cultivated fields and waste ground, introduced from farther west. Circumneutral to calciphile. Clark and Boone counties.

Grindelia squarrosa var. **nuda** (Wood) Gray.

Sometimes found with the typical form. St. Louis and Jackson counties.

Grindelia lanceolata Nutt.

Rocky prairies, glades, and bald knobs, and also sometimes introduced along

railways or in fields. Calciphile. Central and southern Mo.: St. Louis, Jefferson, Butler, Camden, Wright, Douglas, Ozark, Henry, Greene, Taney, Stone, Barry, Vernon, Barton, Jasper, Newton, and McDonald counties.

Grindelia lanceolata f. **latifolia** Steyermark, Ann. Mo. Bot. Gard. **21**: 515. 1934.
Rarely occurring with the species. Southwestern Mo., local: Stone Co.

Gutierrezia dracunculoides (DC.) Blake, Contr. U. S. Nat. Herb. **22**: 592. 1924. August Flower.
Amphiachyris dracunculoides (DC.) Nutt. (G), (B & B).
Dry upland prairies. Circumneutral to calciphile. Western Mo.: Atchison, Jackson, Cass, Cedar, Greene, Jasper, Newton, and McDonald counties, and also introduced in St. Louis Co.

Heterotheca subaxillaris (Lam.) Britton & Rusby.
Loess hills and waste ground. Calciphile to circumneutral. Northwestern Mo.: Atchison Co., and also introduced in Jackson Co.

Chrysopsis camporum Greene. Golden Aster.
Chrysopsis villosa of auth., not Nutt. (G), (B & B).
Sandy open ground. Oxylophile. Eastern Mo., south of the Missouri River: St. Louis, Franklin, Ste. Genevieve, Scott, Mississippi, Stoddard, Dunklin, and Wayne counties.

Chrysopsis pilosa Nutt.
Rocky or sandy prairies and open banks. Oxylophile. Southern Mo.: Dunklin and Jasper counties.

Chrysopsis Berlandieri Greene.
Chrysopsis villosa var. *canescens* (T. & G.) Gray.
Loess hills. Calciphile to circumneutral. Northwestern Mo.: Holt Co.

Aplopappus ciliatus (Nutt.) DC.
Prairies, glades, open alluvial and waste ground. Calciphile. Western Mo.: Clay, Jackson, and Stone counties.

Solidago petiolaris Ait.
Rocky prairies, thickets, and dry open woods. Circumneutral to oxylophile. Central and southern Mo.: St. Louis, Jefferson, Franklin, Ste. Genevieve, St. Francois, Madison, Iron, Reynolds, Butler, Shannon, Dent, Crawford, Gasconade, Wright, Taney, Greene, Stone, Jackson, Jasper, and Newton counties.

Solidago petiolaris var. **Wardii** (Britton) Fernald.
Rocky open woods and thickets. Oxylophile. East-central and southern Mo.: St. Louis, Jefferson, Crawford, Callaway, Montgomery, Boone, Cole, Phelps, Pulaski, Henry, Greene, Stone, Jasper, Newton, and McDonald counties.

Solidago caesia L. Blue-stemmed Goldenrod.
Rocky woods, bluffs, and ledges. Circumneutral to oxylophile. Southern Mo.: Perry, Cape Girardeau, Bollinger, Iron, Wayne, Ripley, Reynolds, Shannon, Oregon, Texas, Howell, Douglas, Ozark, and Barry counties.

Solidago latifolia L.
Rich rocky woods and shaded bluffs. Circumneutral. General but commonest in central and southern Mo.: Putnam, Marion, Ralls, Monroe, Boone, Callaway, Warren, Lincoln, St. Charles, St. Louis, Jefferson, Franklin, Cape Girardeau,

Bollinger, Madison, Iron, Wayne, Carter, Shannon, Oregon, Morgan, Camden, Dallas, Ozark, Taney, Stone, Barry, Jackson, Lafayette, Pettis, Hickory, Greene, and Jasper counties.

Solidago Lindheimeriana Scheele.

Rocky woods and bluffs. Circumneutral. East-central and southern Mo.: Jefferson, Franklin, Carter, Barry, and McDonald counties.

Solidago hispida Muhl.

Rocky open woods and ledges. Oxylophile. East-central and southern Mo.: St. Louis, Jefferson, Franklin, Gasconade, Crawford, Ste. Genevieve, Bollinger, Madison, Iron, Reynolds, Wayne, Carter, Ripley, Oregon, Shannon, Dent, Texas, Howell, Douglas, Ozark, Taney, Stone, Barry, Jasper, Newton, and McDonald counties.

Solidago speciosa Nutt.

Rocky open woods, thickets, prairies, and meadows. Circumneutral. General but scattered.

Solidago speciosa var. **angustata** T. & G.

Frequently found with the typical form. Southern and central Mo. and locally north in Worth, Putnam, and Buchanan counties.

Solidago patula Muhl.

Swampy open ground. Circumneutral. Southeastern Mo.: Bollinger, Iron, and Scott counties.

Solidago arguta Ait.

Rocky open woods and bluffs. Oxylophile to circumneutral. Southern Mo.: Ste. Genevieve, Madison, Reynolds, Carter, Shannon, Oregon, Texas, Howell, Ozark, Taney, Barry, Jasper, Newton, and McDonald counties.

Solidago arguta var. **Boottii** (Hook.) Palmer & Steyermark, comb. nov.

Solidago Boottii Hook. (G), (B & B).

Dry open woods and thickets. Circumneutral to oxylophile. Southern Mo.: Ste. Genevieve, Reynolds, Ripley, Shannon, Texas, Howell, Douglas, Ozark, Barry, Jasper, Newton, and McDonald counties.

Solidago juncea Ait. Early Goldenrod.

Open woods, thickets, and along prairie streams. Circumneutral to oxylophile. Central and southern Mo.: Boone, St. Louis, Scott, Iron, Carter, Shannon, Taney, Barry, Newton, and McDonald counties.

Solidago juncea var. **scabrella** (T. & G.) Gray.

Occasionally found with the typical form. Southwestern Mo.: Taney, Barry, and Newton counties.

Solidago suaveolens Schoepf. See Rh. **21**: 70. 1919. Fragrant Goldenrod.

Solidago odora Ait. (G), (B & B).

Rocky or sandy open woods and thickets. Oxylophile. Southeastern Mo.: Scott, Dunklin, Carter, and Ripley counties.

Solidago microphylla Engelm.

Rocky woods and bluffs. Circumneutral. Southern Mo., local: Ozark Co.

Solidago ulmifolia Muhl.

Open woods, thickets, and alluvial banks. Circumneutral. General.

Solidago rugosa Mill. Rough-leaved Goldenrod.

Rocky prairies, glades, and open woods along streams. Circumneutral to oxylophile. Central and southern Mo.: St. Louis, Jefferson, Ste. Genevieve, Scott, Iron, Wayne, Butler, Dunklin, Texas, Howell, Jackson, Greene, Jasper, and Newton counties.

Solidago rugosa var. **aspera** (Ait.) Fernald, Rh. **17**: 7. 1915.

Solidago aspera Ait. (G).

In similar situations to the typical form. East-central and southeastern Mo.: Lincoln, Perry, Iron, Wayne, Butler, Dunklin, and Shannon counties.

Solidago glaberrima Martens.

Solidago missouriensis of auth., not Nutt. (G).

Open woods, thickets, and prairies. Circumneutral. General.

Solidago glaberrima var. **moritura** (Steele) Palmer & Steyermark, comb. nov.

Solidago moritura Steele (R).

Thickets, prairies, limestone hills, and loess mounds. Calciphile to circumneutral. Western Mo.: Atchison, Holt, Henry, and Vernon counties.

Solidago Gattingeri Chapm.

Rocky open ground, glades, and bald knobs. Calciphile. East-central and southern Mo.: St. Louis, Jefferson, Franklin, Camden, Dallas, Ozark, Taney, Barry, and McDonald counties.

Solidago nemoralis Ait. Gray Goldenrod.

Open woods, thickets, fields, prairies, and waste ground. Oxylophile. General.

Solidago nemoralis var. **longipetiolata** (Mack. & Bush) Palmer & Steyermark, comb. nov.

Solidago longipetiolata Mack. & Bush (R).

Rocky open woods, glades, prairies, and loess hills. Oxylophile to circumneutral. General but scattered: Clark, Boone, St. Louis, Jefferson, St. Francois, Iron, Shannon, Maries, Camden, Worth, Atchison, Holt, Buchanan, Jackson, Jasper, and Barry counties.

Solidago radula Nutt.

Rocky woods, bluffs, and glades. Circumneutral to calciphile. Eastern, central, and southern Mo. south and east of a line drawn from Marion, Monroe, Saline, and Henry counties to Cedar and Jasper counties.

Solidago altissima L.

Fields, prairies, thickets, and waste ground. Circumneutral. General. This is one of the commonest goldenrods in the state, and it has often been confused with *Solidago canadensis*, the typical var. of which is not found in Mo.

Solidago altissima var. **procera** (Ait.) Fernald.

Occasionally found with the typical form.

Solidago canadensis L. var. **gilvocanescens** Rydb.

Fields and prairies. Circumneutral. Scattered: Linn, Pike, Boone, Saline, Jackson, and Greene counties.

Solidago serotina Ait.

Moist open woods and thickets, prairie swales, and banks of streams. Circumneutral. General.

Solidago serotina var. **gigantea** (Ait.) Gray.

Occasionally found with the typical form. Scattered: St. Louis, Dunklin, Boone, Jackson, and Cass counties.

Solidago rigida L.

Prairies, thickets, and rocky open ground. Circumneutral to calciphile. General.

Solidago Drummondii T. & G.

Dry limestone or dolomite bluffs and ledges. Calciphile. Eastern and middle Mo., mostly south of the Missouri River: Monroe, Boone, Callaway, Montgomery, St. Charles, St. Louis, Jefferson, Franklin, Gasconade, Crawford, Washington, St. Francois, Ste. Genevieve, Perry, Bollinger, Madison, Iron, Reynolds, Carter, Oregon, Shannon, Dent, Phelps, Moniteau, Pulaski, Laclede, Texas, Howell, Douglas, and Ozark counties.

Solidago graminifolia (L.) Salisb. Flat-topped Goldenrod.

Euthamia glutinosa Rydb. (R).

Fields and prairies. Circumneutral. General and common.

Solidago gymnospermoides (Greene) Fernald.

Euthamia gymnospermoides Greene (B & B).

Rocky or upland prairies. Circumneutral to calciphile. Middle and western Mo.: Audrain, Boone, Miller, Pettis, Greene, Daviess, Dekalb, Jackson, Cass, Vernon, Barton, Jasper, Newton, and McDonald counties.

Solidago leptocephala T. & G.

Sandy open ground. Oxylophile. Southeastern Mo.: Mississippi, Dunklin, and Butler counties.

Bellis integrifolia Michx. Western Daisy.

Rocky open woods and glades. Calciphile. Southwestern Mo.: Taney and McDonald counties.

Chaetopappa asteroides DC.

Rocky open woods, prairies, and glades. Oxylophile. Southwestern Mo.: Vernon, Jasper, and Newton counties.

Boltonia asteroides (L.) L'Her. False Starwort.

Moist open woods and thickets. Circumneutral. General. Forms of this have been confused with *Boltonia diffusa*, which is not known in Mo.

Boltonia asteroides var. **decurrens** (T. & G.) Engelm.

Frequently found with the typical form. General but scattered.

Boltonia latisquama Gray.

Prairie swales and borders of streams and sloughs. Circumneutral Northern, central, and western Mo.: Knox, Lewis, Shelby, Monroe, Ralls, Pike, Audrain, Ripley, Boone, Randolph, Macon, Linn, Carroll, Livingston, Chariton, Caldwell, Jackson, Lafayette, Pettis, Cass, Henry, Vernon, Greene, and Jasper counties.

Aster paludosus Ait.

Prairies and along railroads. Circumneutral to oxylophile. Southwestern Mo. and locally east in Marion Co. where probably introduced: Marion, Barton, Jasper, Newton, and Barry counties.

Aster furcatus Burgess.

Shaded rocky banks and bluffs of streams. East-central and southern Mo.: Jefferson, Shannon, and Texas counties.

Aster oblongifolius Nutt.

Rocky prairies, open slopes, and glades. Calciphile to circumneutral. General.

Aster oblongifolius var. **rigidulus** Gray.

Frequently found with the typical form. Scattered: St. Louis, Jefferson, Atchison, Holt, Henry, Greene, Ozark, Barry, Jasper, and McDonald counties.

Aster novae-angliae L. New England Aster.

Thickets, prairie swales, and moist open ground along streams. Circumneutral. General but scattered.

Aster sericeus Vent.

Rocky prairies, glades, and loess hills. Calciphile to circumneutral. Central, southern, and northwestern Mo.: St. Louis, Jefferson, Washington, Iron, Dent, Shannon, Oregon, Texas, Howell, Ozark, Camden, Dallas, Hickory, Cedar, Greene, Taney, Stone, Barry, Atchison, Holt, Jackson, Cass, and McDonald counties.

Aster patens Ait. Purple Daisy.

Rocky open woods, thickets, and glades. Circumneutral to oxylophile. General.

Aster patens var. **gracilis** Hook.

Occasionally found with the typical form. Jasper and McDonald counties.

Aster anomalus Engelm.

Rocky open woods and thickets. Oxylophile to circumneutral. Eastern, central, and southern Mo., south and east of a line from Lewis, Boone, and Henry to Jasper Co.

Aster azureus Lindl. Blue Devil.

Rocky open woods, borders of prairies, and glades. Calciphile to circumneutral. General.

Aster azureus × laevis.

Sometimes occurring with the parent species. Prairies and dry open ground. Circumneutral. Scattered in northern and central Mo.: Monroe, Adair, Randolph, Putnam, Daviess, and Caldwell counties.

Aster cordifolius L. Heart-leaved Aster.

Moist alluvial woods, and along shaded bluffs. Circumneutral to oxylophile. General.

Aster cordifolius var. **polycephalus** Porter.

Occasionally found with the typical form. Boone Co.

Aster sagittifolius Wedemeyer.

Rocky woods and glades. Circumneutral to oxylophile. General.

Aster Drummondii Lindl.

Aster hirtellus Lindl. (R).

Rocky open woods and thickets. Circumneutral. General.

Aster turbinellus Lindl.

Rocky open woods, thickets, and glades. Circumneutral to oxylophile. Eastern, central, and southern Mo., south and east of a line from Putnam, Macon, Pettis, and Henry counties to Jasper Co.

Aster laevis L.

Rocky open woods, thickets, glades, prairies, and loess hills. Circumneutral to calciphile. General.

Aster concinnus Willd.

Rocky open woods, prairies, and glades. Calciphile to circumneutral. Central and southern Mo., scattered: St. Louis, Jefferson, Franklin, Maries, Shannon, Ozark, Cooper, Jackson, Jasper, and Newton counties.

Aster polyphyllus Willd.

Rocky open ground. Circumneutral to calciphile. East-central Mo., local: St. Louis Co.

Aster pilosus Willd. See Rh. **32**: 139. 1930. White Heath Aster.

Aster ericoides var. *villosus* T. & G. (G).

Aster ericoides of auth. in part, not L. (B & B).

Fields, prairies, and rocky open ground. Circumneutral to oxylophile. General.

Aster pilosus var. **demotus** Blake, Rh. **32**: 139. 1930.

Aster ericoides of auth., not L. (G), (B & B).

Rocky open woods, thickets, and prairies. Circumneutral to oxylophile. General.

Aster pilosus var. **platyphyllus** (T. & G.) Blake, Rh. **32**: 139. 1930.

Aster ericoides var. *platyphyllus* T. & G. (G).

Occasionally found with the typical form. Scattered: Ralls, St. Louis, and Jackson counties.

Aster ericoides L. See Rh. **32**: 138. 1930, and Rh. **30**: 227. 1928.

Aster multiflorus Ait. (G), (B & B).

Aster multiflorus var. *exiguus* Fernald (G).

Rocky open woods and prairies. Circumneutral. Northern, central, and western Mo., apparently absent from most of the Ozark region: Clark, Lewis, Marion, Ralls, Pike, Lincoln, St. Charles, St. Louis, Warren, Montgomery, Audrain, Monroe, Shelby, Knox, Scotland, Schuyler, Adair, Macon, Randolph, Boone, Howard, Chariton, Linn, Sullivan, Putnam, Mercer, Grundy, Livingston, Carroll, Saline, Cooper, Morgan, Pettis, Greene, Henry, Johnson, Caldwell, Daviess, Harrison, Worth, Gentry, Dekalb, Clinton, Clay, Jackson, Bates, Jasper, Platte, Buchanan, Andrew, Nodaway, Holt, and Atchison counties.

Aster ericoides var. **prostratus** (Ktze.) Blake, Rh. **32**: 138. 1930.

Aster exiguus (Fernald) Rydb., not *Aster multiflorus* var. *exiguus* Fernald.

Aster multiflorus var. *pansus* Blake, Rh. **30**: 227. 1928.

Prairies, dry open ground, along railroads, and sandy or gravelly ground along streams. Circumneutral. Northern, central, and western Mo.: Knox, Macon, Marion, Lincoln, St. Louis, Cole, Montgomery, Randolph, Saline, Linn, Atchison, Jackson, and Jasper counties.

Aster parviceps (Burgess) Mack. & Bush. See Rh. **11**: 59. 1909.

Aster depauperatus var. *parviceps* (Burgess) Fernald (G).

Prairies and open woods. Eastern, central, and southwestern Mo.: Marion, Ralls, Pike, Audrain, St. Louis, Bollinger, Warren, Montgomery, Callaway, Boone, Jackson, and Jasper counties.

Aster parviceps × **pilosus** var. **demotus.**

Sometimes occurring with the parent species. Circumneutral. Northern Mo.: Knox, Marion, Putnam, and Grundy counties.

Aster amethystinus Nutt.

Prairies. Circumneutral. Central Mo., local: Randolph Co. Probably a hybrid between *Aster praealtus* and *Aster novae-angliae* with which species it was found growing.

Aster commutatus (T. & G.) Gray. White Prairie Aster.

Fields and prairies. Circumneutral. Scattered: St. Louis and Jackson counties.

Aster vimineus Lam. var. **subdumosus** Wiegand, Rh. **30**: 171. 1928. Frost Flower.

Aster vimineus of auth. in part (G), (B & B).

Open woods and prairie swales. Circumneutral. General but scattered: Monroe, Warren, St. Louis, Jefferson, Scott, Stoddard, Dunklin, Butler, Wayne, Audrain, Randolph, Linn, Henry, Greene, and Jasper counties. This has been confused with *Aster dumosus* and varieties which are not known to occur in Missouri.

Aster angustus (Lindl.) T. & G.

Open ground, loess hills. Circumneutral to calciphile. Northwestern Mo., local: Atchison Co.

Aster pantotrichus Blake, Jour. Wash. Acad. Sci. **21**: 327. 1931.

Aster missouriensis Britton, not Ktze. (B & B).

Aster lateriflorus var. *thyrsoideus* (Gray) Sheldon (G), in part.

Rocky open woods. Circumneutral to oxylophile. Eastern, central, and southern Mo.: Ralls, Pike, Lincoln, St. Louis, Ste. Genevieve, Iron, Taney, Boone, and Jackson counties.

Aster lateriflorus (L.) Britton var. **pendulus** (Ait.) Burgess. See Rh. **30**: 173. 1928.

Aster lateriflorus of auth. in part (G), (B & B).

Low wet woods and borders of ponds, sloughs, and swales. Circumneutral. General and common. Typical *Aster lateriflorus* is of more northern and eastern range and does not reach Missouri.

Aster paniculatus Lam. Tall White Aster.

Low wet woods and prairie swales. Circumneutral. General.

Aster paniculatus var. **bellidiflorus** (Willd.) Burgess.

Occasionally found with the typical form. Boone and Jackson counties.

Aster paniculatus var. **simplex** (Willd.) Burgess.

Occasionally found with the typical form. Boone, Randolph, and Jasper counties.

Aster praealtus Poir. See Rh. **35**: 21. 1933. Willow-leaved Aster.

Aster salicifolius Ait., in part (G), (B & B).

Wet meadows, prairies, roadsides, and borders of small streams. Circumneutral. General.

Aster praealtus var. **subasper** (Lindl.) Wiegand, Rh. **35**: 24. 1933.

Aster salicifolius var. *subasper* (Lindl.) Gray (G).

Occasionally found with the typical form. Mississippi, Boone, and Jackson counties.

Aster interior Wiegand, Rh. **35**: 35, 312. 1933. Michaelmas Daisy.
Aster Tradescanti of auth. in part, not L. (G), (B & B).
Low wet woods, thickets, and prairie swales. Circumneutral. General.

Aster linariifolius L.
Rocky open woods and glades. Oxylophile. East-central and southern Mo.: St. Louis, Jefferson, Franklin, Ste. Genevieve, Perry, Bollinger, Madison, Iron, Wayne, Ripley, Carter, Reynolds, Oregon, Dent, Shannon, Crawford, Maries, Phelps, Pulaski, Laclede, Texas, Howell, Douglas, Ozark, Greene, Taney, Barry, Jasper, Newton, and McDonald counties.

Aster ptarmicoides T. & G.
Rocky open woods and glades. Calciphile. Central and southern Mo.: Jefferson, Washington, Crawford, Dent, Iron, Shannon, Phelps, Pulaski, Jackson, Greene, Barry, Newton, and McDonald counties.

Aster lateriflorus var. **pendulus** × **pantotrichus.**
Occasionally found with the parent species. St. Louis Co.

Aster lateriflorus var. **pendulus** × **praealtus.**
Occasionally found with the typical form. St. Louis Co.

Erigeron pulchellus Michx. Robin's Plantain.
Rocky open woods and thickets. Oxylophile to circumneutral. General.

Erigeron philadelphicus L.
Fields, open woods, and waste ground. Circumneutral. General.

Erigeron annuus (L.) Pers. Daisy Fleabane.
Fields, prairies, and waste ground. Indifferent. General.

Erigeron ramosus (Walt.) BSP.
Rocky prairies, fields, and glades. Calciphile to circumneutral. General.

Erigeron ramosus var. **Beyrichii** (T. & G.) Trelease.
Occasionally found with the typical form. Jasper Co.

Erigeron tenuis T. & G.
Prairies, fields, and waste ground. Circumneutral. Central and southern Mo., scattered: St. Louis, Jasper, Newton, and McDonald counties.

Erigeron canadensis L.
Fields, roadsides, and waste ground. Indifferent. General and common.

Erigeron divaricatus Michx. Dwarf Fleabane.
Prairies, fields, glades, and waste ground. Oxylophile. General.

Pluchea foetida (L.) DC. Marsh Fleabane.
Swampy open woods and borders of bayous. Circumneutral. Southeastern Mo.: Butler Co.

Pluchea petiolata Cass.
Low wet woods, swamps, and borders of sloughs and bayous. Circumneutral. Southern Mo.: Bollinger, Scott, Mississippi, New Madrid, Pemiscot, Dunklin, Butler, Wayne, Ripley, Oregon, Howell, Taney, Barry, and Jasper counties, and also introduced in Jackson Co.

Antennaria plantaginifolia (L.) Richards. Ladies' Tobacco, Pussy's Toes.
Rocky open woods and thickets. Oxylophile. General.

Antennaria fallax Greene. Indian Tobacco.

Rocky open woods, glades, and prairies. Oxylophile. General. This is a common species in Missouri, and it has often been confused with *A. plantaginifolia.*

Antennaria calophylla Greene.

Antennaria ampla Bush.

Rocky open woods and prairies. Oxylophile to circumneutral. General but scattered: Shelby, Marion, Audrain, Shannon, Ripley, Greene, Christian, Taney, Jasper, and Newton counties.

Antennaria neglecta Greene.

Antennaria longifolia Greene.

Prairies and meadows. Circumneutral. Northern, central, and western Mo.: Schuyler, Scotland, Knox, Shelby, Lewis, Marion, Ralls, Pike, Lincoln, Audrain, Boone, Randolph, Macon, Adair, Sullivan, Linn, Mercer, Grundy, Daviess, Platte, Moniteau, Morgan, Pettis, Hickory, Henry, Cedar, Jackson, Greene, and Jasper counties.

Anaphalis margaritacea (L.) Benth. & Hook. Pearly Everlasting.

Fields and waste ground. Introduced in Boone Co.

Gnaphalium purpureum L. Cudweed.

Fields, prairies, and thickets. Circumneutral to oxylophile. General.

Gnaphalium obtusifolium L. See Rh. **20**: 71. 1918. Everlasting.

Gnaphalium polycephalum Michx. (G).

Rocky prairies, fields, and thickets. Circumneutral to oxylophile. General.

Gnaphalium obtusifolium var. **micradenium** Weatherby, Rh. **25**: 22. 1923.

Rocky open woods. Oxylophile. Southeastern Mo., eastern Ozark region: Ste. Genevieve and Shannon counties.

INULA HELENIUM L. Elecampane.

Wet open ground and waste places. Scattered: Monroe, Boone, and Jackson counties, and also reported from Greene Co.

Polymnia canadensis L.

Rich rocky woods and talus slopes. Circumneutral to calciphile. Eastern, central, and southern Mo., south and east of a line drawn from Marion, Warren, and Boone counties to Jackson Co.

Polymnia canadensis var. **radiata** Gray.

Commonly found with the typical form. Scattered in eastern, central, and southern Mo.: Clark, Marion, St. Louis, Carter, Dent, Phelps, Pulaski, Shannon, Taney, Laclede, Montgomery, Boone, Jackson, and McDonald counties.

Polymnia Uvedalia L. var. **genuina** Blake, Rh. **19**: 47. 1917. Leaf-cup.

Rich woods and along bluffs. Calciphile. Scattered in central and southern Mo.: Boone and Barry counties.

Polymnia Uvedalia var. **densipilis** Blake, Rh. **19**: 48. 1917.

Rich woods, thickets, and along bluffs. Calciphile to circumneutral. Central and southern Mo.: Boone, St. Louis, Jefferson, Dunklin, Butler, Ripley, Shannon, Ozark, Barry, Jasper, Newton, and McDonald counties.

Silphium laciniatum L. Compass Plant.

Prairies and glades. Circumneutral to calciphile. General.

Silphium terebinthinaceum Jacq. Prairie Dock.

Prairies, glades, and bald knobs. Calciphile to circumneutral. Eastern, central, and southern Mo., south and east of a line drawn from Marion, Boone, Benton and Greene counties to Barry Co.

Silphium Asteriscus L. Starry Rosin-weed.

Rocky open woods and glades. Circumneutral to oxylophile. Southern Mo.: Dunklin, Carter, Ripley, Oregon, Shannon, Texas, Howell, Douglas, Ozark, Stone, and Barry counties.

Silphium integrifolium Michx. Rosin-weed.

Rocky open woods, glades, and prairies. Circumneutral to calciphile. General.

Silphium perfoliatum L. Cup Plant.

Moist prairies, thickets, and borders of streams and ponds. Circumneutral. General.

Berlandiera texana DC.

Rocky open woods and thickets. Circumneutral to calciphile. Southern Mo.: Phelps, Pulaski, Carter, Dent, Shannon, Oregon, Howell, Douglas, Ozark, Taney, Stone, Greene, Lawrence, Barry, Jasper, Newton, and McDonald counties.

Engelmannia pinnatifida T. & G.

Waste ground and along railroads. Introduced from farther west. Jackson Co.

Parthenium integrifolium L.

Rocky woods, thickets, and glades. Calciphile to circumneutral. General.

Parthenium hispidum Raf.

Parthenium repens Eggert (G).

Prairies and glades. Calciphile. Central and southern Mo.: St. Louis, Jefferson, Franklin, St. Francois, Iron, Washington, Crawford, Dent, Shannon, Oregon, Texas, Phelps, Maries, Pulaski, Miller, Camden, Laclede, Dallas, Wright, Webster, Douglas, Ozark, Taney, Stone, Greene, Polk, Hickory, Cedar, Barry, Jasper, Newton, and McDonald counties.

Parthenium Hysterophorus L. Santa Maria.

Waste ground and along railroads. Introduced in Jackson Co.

Iva ciliata Willd. Marsh Elder.

Prairies, fields, and waste ground. Circumneutral to oxylophile. General but scattered, and apparently absent from much of the Ozark region: Clark, Linn, Randolph, Monroe, Pike, Lincoln, St. Charles, St. Louis, Jefferson, Perry, Mississippi, New Madrid, Pemiscot, Gasconade, Miller, Morgan, Saline, Livingston, Clay, Jackson, Lafayette, Henry, Greene, Bates, Vernon, Barton, Jasper, and Newton counties.

Iva xanthifolia Willd.

Fields, alluvial and waste ground. Indifferent. Northwestern and west-central Mo.: Atchison, Buchanan, and Jackson counties. Introduced from the Northwest.

Ambrosia bidentata Michx.

Rocky prairies, fields, and waste ground. Circumneutral to oxylophile. General.

Ambrosia bidentata × trifida.
Rarely occurring with the parent species. Local: Morgan Co.

Ambrosia trifida L. Horse-weed.
Ambrosia striata Rydb. (R).
Alluvial fields, borders of woods, and waste ground. Circumneutral. General and common.

Ambrosia trifida var. **integrifolia** (Muhl.) T. & G.
Sometimes found with the typical form.

Ambrosia artemisiaefolia L. var. **elatior** (L.) Desc. See Rh. **37**: 185. 1935. Ragweed, Roman Wormwood.
Ambrosia artemisiifolia of auth., not L. (G), (B & B).
Fields and waste ground. Indifferent. General and common.

Ambrosia artemisiaefolia var. **elatior** f. **villosa** Fernald & Griscom, Rh. **37**: 185. 1935.
Commonly occurring with the preceding variety. General.

Ambrosia psilostachya DC.
Rocky prairies, pastures, and glades. Circumneutral to oxylophile. Northern, central, and western Mo., absent from most of the Ozark region: Clark, Marion, Pike, Montgomery, St. Louis, St. Francois, Randolph, Boone, Carroll, Saline, Atchison, Holt, Andrew, Buchanan, Dekalb, Clinton, Jackson, Barton, and Jasper counties.

Ambrosia aptera DC.
Introduced in waste ground. St. Louis Co.

Xanthium acerosum Greene. Cocklebur.
Introduced in waste ground. Jackson Co.

Xanthium italicum Mor.
Xanthium glanduliferum Greene (R).
Xanthium commune Britton (G), (B & B).
Fields, roadsides, and waste ground. Indifferent. General.

Xanthium speciosum Kearney.
Cultivated fields and waste ground. Indifferent. Western Mo., scattered: Jackson, Cass, and Jasper counties.

Xanthium inflexum Mack. & Bush.
Low cultivated ground. Indifferent. Western Mo: Jackson Co.

Xanthium echinatum Murr.
Cultivated and waste ground. Scattered: St. Louis, Jefferson, Jackson, and Jasper counties.

Xanthium globosum Shull, Bot. Gaz. **59**: 482, *figs. 1, 4, 5, 7.* 1915.
Low alluvial fields, roadsides, and waste ground. Indifferent. Scattered: Randolph, Cass, and Jasper counties.

XANTHIUM SPINOSUM L.
Fields and waste ground. Indifferent. Eastern Mo.: St. Louis Co.

Xanthium pennsylvanicum Wallr.
Cultivated fields, roadsides, and waste ground. Indifferent. General.

Xanthium chinense Mill.
Xanthium canadense of auth., not Mill. (G).

Fields, roadsides, waste and alluvial ground, often in moist soil along ponds, sloughs, streams, and swampy open woods. Indifferent. General: Schuyler, Sullivan, Boone, Montgomery, Warren, St. Charles, St. Louis, Mississippi, New Madrid, Jefferson, Dent, Maries, Pettis, Linn, Jackson, Greene, Jasper, and McDonald counties.

Xanthium chinense × pennsylvanicum.

Occasionally found with the parent species. Knox and St. Louis counties.

Xanthium italicum × pennsylvanicum.

Occasionally found with the parent species. Montgomery and St. Louis counties.

Heliopsis scabra Dunal. Rough Ox-eye.

Rocky woods and thickets. Circumneutral. General.

Heliopsis helianthoides (L.) Sweet. Ox-eye.

Rocky woods and thickets. Circumneutral. Eastern and middle Mo.

Eclipta alba (L.) Hassk.

Moist fields, open ground, and borders of sloughs and ponds. Circumneutral. General, but commonest along the larger rivers.

Rudbeckia triloba L. Brown-eyed Susan.

Rocky woods, thickets, and open banks. Circumneutral. General.

Rudbeckia subtomentosa Pursh.

Moist open woods, thickets, and borders of prairie streams. Circumneutral. General.

Rudbeckia subtomentosa var. **Craigii** Sherff, Rh. **14:** 164. 1912.

Occasionally found with the typical form. St. Louis Co.

Rudbeckia speciosa Wenderoth.

Rocky open woods, glades, and thickets. Circumneutral. Southern Mo.: Iron, Shannon, Jasper, and Newton counties.

Rudbeckia palustris Eggert.

Wet ground about springs, wet ledges and banks. Calciphile to circumneutral. Southern Mo.: Iron, Wayne, Ripley, Dent, Shannon, Texas, Douglas, Ozark, and Taney counties.

Rudbeckia hirta L. Black-eyed Susan, Nigger Head.

Rudbeckia sericea Moore (S).

Rudbeckia longipes Moore (S).

Open woods, thickets, rocky prairies, and waste ground. Circumneutral. General and common.

Rudbeckia missouriensis Engelm.

Rudbeckia fulgida of auth. in part, not Ait. (G), (B & B).

Rocky prairies, glades, and bald knobs. Calciphile. Southern and central Mo. south and east of a line drawn from St. Charles, Montgomery, Boone, Morgan, Hickory, and Polk counties to Benton Co. This species has been confused with *Rudbeckia fulgida* which is not known to occur in Mo.

Rudbeckia grandiflora Gmel.

Dry open ground. Eastern Ozark region: Washington and Shannon counties, and also introduced in Boone and Jackson counties.

Rudbeckia laciniata L.

Low open woods, alluvial thickets, and banks of small streams. Circumneutral. General.

Rudbeckia maxima Nutt.

Open and waste ground. Introduced from the southwest. Jackson Co.

Rudbeckia amplexicaulis Vahl.

Roadsides and waste ground. Circumneutral to calciphile. Introduced in western Mo.: Jackson, Jasper, and Newton counties.

Echinacea purpurea (L.) Moench. Purple Cone-flower.

Brauneria purpurea (L.) Britton (G).

Rocky open woods, thickets, and glades. Calciphile to circumneutral. General but commonest in southern and central Mo.

Echinacea angustifolia DC.

Upland prairies. Circumneutral. Northeastern Mo., local: Shelby Co.

Echinacea pallida Nutt.

Brauneria pallida (Nutt.) Britton (G).

Rocky prairies and glades. Calciphile to circumneutral. General.

Echinacea paradoxa (Norton) Britton.

Brauneria paradoxa Norton (G).

Rocky prairies, glades and bald knobs. Southern Mo., central and western Ozark region: Phelps, Pulaski, Miller, Camden, Laclede, Benton, Dallas, Cedar, Greene, Ozark, Taney, Stone, and Barry counties.

Ratibida pinnata (Vent.) Barnhart.

Lepachys pinnata (Vent.) T. & G. (G).

Rocky prairies, thickets, and borders of woods. Circumneutral. General.

Ratibida columnaris (Sims) D. Don.

Lepachys columnaris (Sims) T. & G. (G).

Prairies, waste ground, and along roadsides and railroads. Circumneutral. Scattered: Marion, Lincoln, St. Louis, Clay, Jackson, Greene, and Jasper counties. Generally and perhaps everywhere introduced from farther west.

Ratibida columnaris f. **pulcherrima** (DC.) W. M. Sharp, Ann. Mo. Bot. Gard. **22**: 70. 1935.

Lepachys columnaris var. *pulcherrima* (DC.) T. & G. (G).

Waste ground. Introduced in Jackson Co.

Spilanthes americana (Mutis) Hieronymus var. **repens** (Walt.) A. H. Moore.

Low wet woods, and borders of swamps and bayous. Circumneutral. Southeastern Mo.: Bollinger, New Madrid, Pemiscot, Dunklin, Butler, and Ripley counties.

Helianthus annuus L. Sunflower.

Waste and cultivated ground. Indifferent. General but scattered.

Helianthus petiolaris Nutt. Prairie Sunflower, Kansas Sunflower.

Fields, roadsides, and waste ground. Circumneutral to oxylophile. Scattered: Marion, St. Louis, Scott, Oregon, Jackson, and Jasper counties.

Helianthus divaricatus L.

Rocky woods and thickets. Circumneutral. Eastern Mo.: Marion, Ralls, Pike, St. Louis, Bollinger, New Madrid, Reynolds, and Oregon counties.

Helianthus lenticularis Dougl.

Waste ground. Introduced in Jackson Co.

Helianthus salicifolius A. Dietr. See Papers Mich. Acad. Sci. **9**: 333. 1929.

Helianthus orgyalis DC. (G), (B & B).

Upland prairies and limestone glades. Calciphile. Western Mo.: Jackson, Henry, Bates, Vernon, and Jasper counties.

Helianthus atrorubens L. var. **pubescens** Ktze. See Rh. **34**: 1–2. 1932.

Dry open ground. Circumneutral. Southern Mo.: Scott, Stoddard, Dunklin, Butler, Wayne, Carter, Ripley, Oregon, Howell, and Ozark counties.

Helianthus rigidus (Cass.) Desf. See Papers Mich. Acad. Sci. **9**: 344. 1929.

Helianthus scaberrimus Ell. (G), (B & B).

Rocky open woods, thickets, and prairies. Circumneutral. General except in Southeastern lowlands and parts of the Ozark region.

Helianthus laetiflorus Pers.

Prairies, thickets, and open banks. Circumneutral. Scattered: Ralls, St. Louis, Jefferson, and Jackson counties.

Helianthus occidentalis Riddell.

Rocky open woods, prairies, and glades. Circumneutral to calciphile. Central and southern Mo.: St. Louis, Franklin, Washington, St. Francois, Crawford, Maries, Phelps, Pulaski, Dent, Shannon, Oregon, Howell, Texas, Wright, Douglas, Camden, Dallas, Barry, Vernon, Jasper, and McDonald counties.

Helianthus mollis Lam.

Prairies, fields, thickets, and roadsides. Circumneutral. General.

Helianthus grosseserratus Martens.

Fields, prairies, and borders of small streams. Circumneutral. Northern, central, and western Mo. Known south of the Missouri River in St. Louis, Jefferson, Iron, Moniteau, Hickory, Cooper, Saline, Pettis, Lafayette, Johnson, Henry, Greene, Jackson, Cass, Bates, Barton, and Jasper counties, and in all of the northern counties.

Helianthus Maximiliani Schrad.

Rocky prairies, glades, loess hills, and bald knobs. Circumneutral to calciphile. Western and southern Mo., scattered: Atchison, Jackson, Ozark, Taney, Stone, and Barry counties.

Helianthus microcephalus T. & G. Small Woods Sunflower.

Moist open woods and thickets. Circumneutral to oxylophile. Southeastern Mo.: Iron, Scott, and Dunklin counties.

Helianthus doronicoides Lam.

Open woods, thickets, and prairies. Circumneutral. Scattered: Schuyler, Boone, St. Louis, Shannon, and Jasper counties.

Helianthus formosus E. E. Wats. Papers Mich. Acad. Sci. **9**: 445, *pl. 72.* 1929.

Open woods and along bluffs. Circumneutral to calciphile. Eastern and southern Mo.: Marion, St. Louis, Jefferson, Shannon, and Greene counties.

Helianthus angustifolius L.

Sandy open woods and prairies. Oxylophile. Southeastern Mo.: Scott, Mississippi, and Butler counties.

Helianthus hirsutus Raf.

Helianthus leptocaulis (Wats.) Blake.

Rocky open woods, thickets, and prairies. Circumneutral. General.

Helianthus hirsutus var. **trachyphyllus** T. & G.

Prairies and thickets. Occasionally found with the typical form. Jasper Co.

Helianthus hirsutus var. **leoninus** (E. E. Wats.) Palmer & Steyermark, comb. nov.

Helianthus leoninus E. E. Wats.

Helianthus virilis E. E. Wats.

Open woods and roadsides. Circumneutral. Scattered: Marion, Lafayette, Clay, Jackson, and Buchanan counties.

Helianthus strumosus L.

Prairie swales and moist ground along streams. Circumneutral. General but scattered: Marion, Ralls, Pike, St. Louis, Crawford, Dunklin, Boone, Taney, Jackson, and Jasper counties.

Helianthus tracheliifolius Mill.

Introduced in waste ground. Jackson Co.

Helianthus decapetalus L.

Open woods, thickets, and prairies. General but scattered: Marion, Ralls, Boone, Dunklin, and Jasper counties.

Helianthus tuberosus L. Jerusalem Artichoke.

Moist woods and thickets, wet prairies, and waste ground. Circumneutral. General.

Helianthus tuberosus var. **subcanescens** Gray.

Helianthus subcanescens (Gray) E. E. Wats.

Helianthus mollissimus E. E. Wats.

Commonly found with the typical form. Scattered: Audrain, St. Louis, Jefferson, Jackson, and Jasper counties.

Helianthus instabilis E. E. Wats. Papers Mich. Acad. Sci. **9**: 423. *pl. 65.* 1929.

Moist prairies and roadsides. Circumneutral. Scattered.

Verbesina encelioides (Cav.) Benth. & Hook. var. **exauriculata** Robinson & Greenman.

Introduced in waste ground. St. Louis and Jackson counties.

Verbesina virginica L. White Crown-beard.

Rocky open woods and thickets. Circumneutral. East-central and southern Mo.: St. Louis, Jefferson, Franklin, Washington, Dent, Iron, Scott, Stoddard, Dunklin, Shannon, Texas, Howell, Phelps, Pulaski, Douglas, Ozark, Taney, Greene, Webster, Stone, Barry, Vernon, Barton, Jasper, Newton, and McDonald counties.

Verbesina helianthoides Michx.

Rocky open woods and thickets. Circumneutral. General.

Actinomeris alternifolia (L.) DC.

Low open woods and thickets. Circumneutral. General.

Coreopsis tinctoria Nutt.

Glades and sandy or rocky open ground. Oxylophile to circumneutral. Scattered: Schuyler, Boone, Cole, Phelps, Butler, Ripley, Oregon, Jackson, Jasper, and Newton counties. Native in southern Mo., and escaped from cultivation northward.

Coreopsis lanceolata L. Tickseed Coreopsis.

Rocky prairies, glades, and fields. Oxylophile. Central and southern Mo. north to St. Louis, Saline, and Clay counties, and escaped from cultivation in Pike Co.

Coreopsis lanceolata var. **villosa** Michx.

Coreopsis crassifolia Ait. (B & B), (R).

Rocky prairies and glades. Oxylophile. East-central and southern Mo.: St. Louis, Jefferson, Franklin, Shannon, Texas, Howell, Ozark, Barry, Jasper, and McDonald counties.

Coreopsis grandiflora Hogg.

Prairies, meadows, glades, and thickets. Circumneutral to oxylophile. Western and southern Mo.: Wayne, Ripley, Jackson, Henry, St. Clair, Cedar, Bates, Vernon, Greene, Jasper, and Newton counties.

Coreopsis pubescens Ell. Star Tickseed.

Rocky open woods, thickets, and along gravelly beds of streams. Oxylophile to circumneutral. Eastern, central, and southern Mo.: Marion, St. Louis, Jefferson, Franklin, Washington, Crawford, Iron, Reynolds, Ripley, Shannon, Oregon, Howell, Texas, Pulaski, Miller, Dallas, Hickory, Polk, Wright, St. Clair, Cedar, Greene, Taney, Douglas, Jasper, Newton, and McDonald counties.

Coreopsis palmata Nutt.

Open woods, glades, thickets, and rocky prairies. Circumneutral to oxylophile. General, but commonest in the Ozark region.

Coreopsis tripteris L. Tall Tickseed.

Rocky open woods, bluffs, thickets, and prairies. Circumneutral to calciphile. General, but commonest in the Ozark region.

Coreopsis tripteris var. **Deamii** Standley, Rh. **32**: 33. 1930.

Occasionally found with the typical form. Scattered: St. Louis, Oregon, Warren, Boone, Dekalb, Harrison, Mercer, and Saline counties.

Bidens discoidea (T. & G.) Britton.

Wet ground along streams, and about ponds. Circumneutral. Eastern Mo.: Lincoln, St. Louis, Jefferson, Cape Girardeau, and Butler counties.

Bidens frondosa L. Beggar-ticks.

Moist woods, thickets, and waste ground. Circumneutral. General.

Bidens vulgata Greene.

Moist ground along streams and about ponds, fields, thickets, and waste ground. Circumneutral. General but scattered: Marion, Pike, St. Louis, Shannon, Atchison, and Jackson counties.

Bidens vulgata var. **puberula** (Wiegand) Greene.

Occasionally found with the typical form. Western Mo.: Atchison and Jackson counties.

Bidens comosa (Gray) Wiegand.

Wet ground, borders of streams, sloughs, and ponds. Circumneutral. General but scattered: Putnam, Boone, Pike, St. Louis, Saline, Atchison, Clay, Jackson, and Greene counties.

Bidens comosa var. **acuta** Wiegand.

Occasionally found with the typical form. St. Louis, Perry, Carroll, Gentry, and Jackson counties.

Bidens connata Muhl. Swamp Beggar-ticks.

Wet borders of streams, ponds, and sloughs. Circumneutral. General but scattered: Marion, Pike, Boone, St. Louis, Saline, Atchison, Jackson, and Green counties.

Bidens cernua L. See Rh. **24**: 206. 1922. Sticktight.

Muddy borders of slow streams, sloughs, and ponds. Circumeutral. General.

Bidens cernua var. **elliptica** Wiegand.

Occasionally found with the typical form. Western Mo.: Jackson and Jasper counties.

Bidens cernua var. **integra** Wiegand.

Frequently found throughout the range of the typical form.

Bidens laevis (L.) BSP.

Wet ground about sloughs and ponds. Circumneutral. Eastern Mo., south of the Missouri River: St. Louis, Jefferson, and Dunklin counties.

Bidens bipinnata L. Spanish Needles.

Open woods, thickets, fields, and waste ground. Circumneutral. General.

Bidens aristosa (Michx.) Britton.

Prairies, cultivated fields, and waste ground. Circumneutral. General, but most common in prairie regions and in alluvial valleys.

Bidens aristosa var. **Fritcheyi** Fernald, Rh. **15**: 78. 1913.

Occasionally found with the typical form. Scattered: Marion, St. Louis, and Jasper counties.

Bidens aristosa var. **mutica** (Gray) Gattinger. See Rh. **15**: 78. 1913.

Sometimes found with the typical form. Scattered: Lewis, Marion, Ralls, Pike, St. Louis, Phelps, Jackson, and Greene counties.

Bidens involucrata (Nutt.) Britton.

Wet prairies, cultivated or fallow fields, and waste ground. Circumneutral. General.

Bidens Beckii Torr. Water Marigold.

Wet ground about ponds and sloughs. Circumneutral. Eastern Mo., local: St. Louis Co.

Thelesperma trifidum (Poir.) Britton.

Rocky prairies and glades. Calciphile. Southwestern Mo., local: Greene Co.

Thelesperma gracile (Torr.) Gray.

Waste ground and along railroads. Introduced in Jackson Co.

Marshallia caespitosa Nutt.

Rocky or upland prairies and glades. Calciphile to circumneutral. Southwestern Mo.: Jasper and Newton counties.

Marshallia obovata (Walt.) Beadle & Boynton var. **platyphylla** (Curtis) Beadle & Boynton. False Scabish.

Glades and bald knobs. Calciphile. Southern Mo., local: Ozark Co.

GALINSOGA PARVIFLORA Cav.

Waste and cultivated ground. Indifferent. Scattered.

GALINSOGA CILIATA (Raf.) Blake, Rh. **24**: 35. 1922.

Galinsoga parviflora var. *hispida* DC. (G).

Waste and cultivated ground. Indifferent. General.

Flaveria campestris Johnston.
Fields and waste ground. Introduced from farther west. Marion and Jackson counties.

Hymenopappus scabiosaeus L'Her.
Hymenopappus carolinensis (Lam.) Porter (G), (B & B), (R).
Rocky prairies, glades, bald knobs, and sandy open woods. Circumneutral to oxylophile. Southern Mo.: Scott, Mississippi, Taney, Stone, and Barry counties. This has been confused with *Hymenopappus corymbosus* which is not known in Mo.

Palafoxia callosa (Nutt.) T. & G.
Polypteris callosa (Nutt.) Gray (G).
Othake callosum (Nutt.) Bush (B & B).
Glades, bald knobs, rocky open ground, and along gravelly beds of streams. Calciphile. Southwestern Mo.: Douglas, Ozark, Greene, Taney, Stone, Barry, and McDonald counties.

Helenium nudiflorum Nutt. Sneezeweed.
Helenium campestre Small (S).
Helenium polyphyllum Small (R).
Moist ground, meadows and fields, and borders of ponds, sloughs, and streams. Circumneutral. General, but commonest in central and southern Mo.

Helenium autumnale L.
Helenium latifolium Mill. (R), (S).
Helenium altissimum Link (R).
Moist ground, prairie swales, and borders of ponds and streams. Circumneutral. General and common.

Helenium tenuifolium Nutt. Bitterweed, Yellow Dog Fennel.
Fields and waste ground. Oxylophile. General, but commonest in the Ozark region. Generally and perhaps everywhere introduced from farther south, and sometimes becoming a troublesome weed.

Gaillardia lutea Greene.
Moist sandy open ground. Oxylophile to circumneutral. Southeastern Mo., local: Dunklin Co.

Gaillardia pulchella Foug. Indian Blanket.
Fields and waste ground. Circumneutral. Introduced or escaped from cultivation. Pike, Platte, and Jackson counties.

TAGETES ERECTA L.
Roadsides and waste ground. Escaped from cultivation. Scattered: Marion, St. Louis, and St. Francois counties.

Dyssodia papposa (Vent.) Hitchc. Fetid Marigold.
Dry prairies, fields, and waste ground. Circumneutral to oxylophile. General.

Achillea Millefolium L. Yarrow.
Prairies, thickets, and waste ground. Indifferent. General and common.

Achillea Millefolium f. **rosea** Rand & Redfield.
Commonly occurring with the typical form. General.

Achillea lanulosa Nutt.
Fields and waste ground. Circumneutral. Scattered: Sullivan, Marion, Monroe, St. Louis, Linn, Moniteau, Wright, and Vernon counties.

ANTHEMIS COTULA L. Dog Fennel.

Fields and waste ground; frequently about dwellings. Indifferent. General.

ANTHEMIS ARVENSIS L. var. AGRESTIS (Wallr.) DC. Corn Chamomile.

Fields and waste ground. Indifferent. Scattered: Jackson and Jasper counties.

ANTHEMIS TINCTORIA L. Yellow Chamomile.

Escaped from cultivation. Local: Greene Co.

MATRICARIA CHAMOMILLA L. Wild Chamomile.

Introduced in waste ground. Indifferent. Scattered: St. Louis and Phelps counties.

MATRICARIA MATRICARIOIDES (Less.) Porter. Pineapple Weed.

Matricaria suaveolens (Pursh) Buchenau (G), (B & B).

Rocky waste ground, fields, and roadsides. Oxylophile to circumneutral. Central and southern Mo., scattered: St. Louis, Jefferson, Franklin, Jasper, and Newton counties.

CHRYSANTHEMUM LEUCANTHEMUM L. Ox-eye Daisy.

Fields, pastures, roadsides, and waste ground. Scattered: St. Louis, Boone, Platte, and Jackson counties.

CHRYSANTHEMUM LEUCANTHEMUM var. PINNATIFIDUM Lecoq & Lamotte.

Fields, rocky pastures, and waste ground. Indifferent. General and more common than the typical form.

TANACETUM VULGARE L. Tansy.

Fields and waste ground. Indifferent. General but scattered.

TANACETUM VULGARE var. CRISPUM DC.

Rarely found with the typical form. Boone Co.

Artemisia dracunculus L. var. **glauca** Jepson.

Artemisia dracunculoides Pursh (G), (B & B).

Prairies, rocky or alluvial banks, and loess hills. Calciphile to circumneutral. Northern Mo., scattered: Clark, Holt, Buchanan, and Jackson counties.

Artemisia campestris L. var. **caudata** (Michx.) Palmer & Steyermark, comb. nov. Wild Wormwood.

Artemisia caudata Michx. (G), (B & B).

Artemisia campestris subsp. *caudata* (Michx.) Hall & Clements.

Glades, bluffs, and gravel bars of streams. Oxylophile. Eastern Mo., south of the Missouri River: St. Louis, Jefferson, Dent, and Shannon counties.

Artemisia frigida Willd. Wormwood Sage.

Waste ground. Introduced from farther west. Jackson Co.

ARTEMISIA ANNUA L. Wormwood.

Fields, and rocky or waste ground. Indifferent. Eastern, central, and southern Mo., commonest in the Ozark region.

Artemisia biennis Willd.

Waste ground and gravel bars of streams. Circumneutral. Scattered: St. Louis, Iron, Clay, and Jackson counties.

Artemisia vulgaris L. var. **ludoviciana** (Nutt.) Ktze. Mugwort.

Artemisia ludoviciana Nutt. (G) in part, (B & B).

Rocky prairies, pastures, and glades. Calciphile to circumneutral. General but scattered.

Artemisia vulgaris var. **Wrightii** (Gray) Palmer & Steyermark, comb. nov.

Artemisia Wrightii Gray.

Artemisia vulgaris subsp. *Wrighti* Hall & Clements.

Artemisia kansana Britton (G), (B & B).

Artemisia Carruthi Wood.

Waste ground. Introduced from the Southwest. Jackson Co.

Artemisia vulgaris var. **gnaphalodes** (Nutt.) Ktze.

Artemisia gnaphalodes Nutt. (B & B).

Artemisia ludoviciana of auth. in part, not Nutt. (G) in part.

Upland prairies and glades. Circumneutral to calciphile. Northern, central, and western Mo.: Clark, Knox, Adair, Marion, Ralls, St. Charles, St. Louis, Mercer, Worth, Grundy, Carroll, Saline, Harrison, Caldwell, Gentry, Dekalb, Atchison, Holt, Clinton, Clay, Jackson, and Dade counties.

Artemisia vulgaris var. **mexicana** (Willd.) Torr. & Gray.

Artemisia mexicana Willd. (B & B).

Artemisia Lindheimeriana Scheele.

Rocky prairies and glades. Calciphile to circumneutral. Western and middle Mo.: Phelps, Macon, Chariton, Boone, Saline, Henry, Jackson, Barton, Jasper, and Newton counties.

Erechtites hieracifolia (L.) Raf. var. **intermedia** Fernald, Rh. **19**: 27. 1917. Fireweed.

Erechtites hieracifolia of auth. in part (G), (B & B).

Rocky open woods, thickets, and waste ground; also often in burned-over woods. Indifferent. General. The typical form is of more northern range and is not known in Missouri.

Cacalia atriplicifolia L.

Open woods and thickets. Circumneutral. General.

Cacalia suaveolens L.

Rich or wet open woods. Circumneutral. East-central Mo.: Warren, St. Louis, and Jefferson counties.

Cacalia reniformis Muhl.

Rich or moist rocky woods. Circumneutral. Eastern, middle, and southern Mo.: Putnam, Sullivan, Schuyler, Adair, Clark, Ralls, Boone, Montgomery, Warren, St. Louis, Jefferson, Franklin, Ste. Genevieve, Cape Girardeau, Bollinger, Shannon, Texas, Howell, Douglas, Barry, and McDonald counties.

Cacalia tuberosa Nutt. Indian Plantain.

Prairies and limestone glades. Calciphile to circumneutral. General but commonest in the glades of the Ozark region.

Senecio glabellus Poir. Butter-weed.

Low alluvial ground along streams, and borders of sloughs and swamps. Circumneutral. Northern, eastern, and central Mo., mostly along the larger rivers: Shelby, Ralls, Lincoln, St. Louis, Jefferson, Ste. Genevieve, Bollinger, Mississippi, Pemiscot, Dunklin, Stoddard, Butler, Ripley, Oregon, Linn, Livingston, Boone, Howard, Saline, Clay, and Jackson counties.

Senecio obovatus Muhl. Squaw-weed.

Rich woods and moist ledges along bluffs. Circumneutral to calciphile. Central and southern Mo., scattered: Jefferson, Boone, Phelps, Shannon, Greene, Taney, Vernon, Jasper, and McDonald counties.

Senecio obovatus var. **rotundus** Britton.

In similar situations to the preceding, but more common. Circumneutral. Central and southern Mo. south and east of a line drawn from St. Louis, Montgomery, Boone, and Morgan counties to Jasper Co.

Senecio obovatus var. **umbratilis** Greenman.

Occasionally found with the typical form. Circumneutral. Scattered. Shannon and Moniteau counties.

Senecio aureus L. Golden Ragwort, Squaw-weed.

Rich or rocky woods, and along spring brooks and streams. Circumneutral. General.

Senecio aureus var. **semicordatus** (Mack. & Bush) Greenman, Ann. Mo. Bot. Gard. **3**: 129. 1916.

Senecio aureus × *Balsamitae* Greenman.

Prairies swales. Circumneutral. Western Mo., local: Jackson Co.

Senecio aureus var. **gracilis** (Pursh) Britton.

Moist woods and prairie swales. Circumneutral. Scattered: Randolph and Douglas counties.

Senecio plattensis Nutt. Prairie Ragwort.

Senecio pseudotomentosus Mack. & Bush (B & B).

Upland prairies, glades, rocky woods, and ledges. Circumneutral to calciphile. General.

Senecio pauperculus Michx. See Ann. Mo. Bot. Gard. **3**: 159. 1916.

Senecio Balsamitae Muhl. (G), (B & B).

Senecio pauperculus var. *Balsamitae* (Muhl.) Fernald.

Prairies and meadows. Circumneutral. Northeastern and central Mo.: Adair, Macon, Knox, Shelby, Marion, Ralls, Pike, Audrain, Randolph, Boone, Callaway, Moniteau, Pettis, and Henry counties.

Arctium minus Bernh. Burdock.

Waste ground, frequently about dwellings. Indifferent. General and common.

Arctium tomentosum Mill. See Rh. **12**: 44–45. 1910.

Waste ground. Introduced in Jackson Co.

Carduus crispus L. Curly Thistle.

Waste ground and roadsides. Introduced in St. Louis Co.

Cirsium lanceolatum (L.) Hill. Bull Thistle.

Fields, pastures, and waste ground. Indifferent. General.

Cirsium undulatum (Nutt.) Spreng. var. **megacephalum** (Gray) Fernald.

Loess hills and prairies. Scattered: Wayne, Atchison, and Jackson counties.

Cirsium discolor (Muhl.) Spreng.

Prairies, thickets, and open woods. Circumneutral. General but scattered: Mercer, Marion, Boone, St. Louis, Dunklin, Vernon, Barton, and Jasper counties.

Cirsium odoratum (Muhl.) Petrak, Beih. z. Bot. Centralbl. II. **35**: 378–381. 1917.

Cirsium pumilum Spreng. (G).

Cirsium Hillii (Canby) Fernald (G), (B & B).

Waste ground. Introduced in St. Louis Co.

Cirsium ochrocentrum Gray var. **Helleri** (Small) Petrak, Beih. z. Bot. Centralbl. II. **35**: 418–419. 1917.

Waste ground. Introduced in Jackson Co.

Cirsium altissimum (L.) Spreng. See Beih. z. Bot. Centralbl. II. **35**: 396–400. 1917.

Cirsium iowense (Pammel) Fernald (R).

Thickets, dry open or low alluvial woods, and rocky slopes. Circumneutral to oxylophile. General. The characters used to distinguish *Cirsium iowense* do not seem constant and it intergrades freely with true *C. altissimum.*

Cirsium virginianum (L.) Michx.

Rocky open woods and thickets. Oxylophile to circumneutral. Southern Mo., eastern Ozark region: St. Francois, Iron, Madison, Wayne, Carter, Ripley, Dent, and Phelps counties.

Cirsium muticum Michx. Swamp Thistle.

Swampy ground. Circumneutral. Eastern Mo., south of the Missouri River: St. Louis and Shannon counties.

CIRSIUM ARVENSE (L.) Scop. Canada Thistle.

Fields and waste ground. Indifferent. Scattered: Adair, St. Louis, Jefferson, St. Francois, and Jackson counties.

ONOPORDUM ACANTHIUM L. Cotton Thistle, Scotch Thistle.

Waste ground. Indifferent. Southeastern Mo.: Iron, St. Francois, and Cape Girardeau counties.

CENTAUREA CYANUS L. Ragged Robbin, Bachelor's Button.

Waste ground and roadsides. Escaped from cultivation. Indifferent. Scattered: Boone, Jackson, and Jasper counties.

CENTAUREA SOLSTITIALIS L. Barnaby's Thistle.

Fields and waste ground. Introduced in Boone Co.

CENTAUREA MELITENSIS L.

Waste ground. Introduced in Jackson Co.

CENTAUREA VOCHINENSIS Bernh.

Fields and waste ground. Introduced in Boone and St. Louis counties.

CENTAUREA MACULOSA Lam.

Old fields and waste ground. Scattered. Introduced in Boone and Howell counties.

CENTAUREA PICRIS Pall.

Waste ground. Introduced in Jackson Co.

Centaurea americana Nutt.

Rocky open woods, glades, and bald knobs. Southwestern Mo.: Barry and McDonald counties, and also introduced in St. Louis and Jackson counties.

Serinia oppositifolia (Raf.) Ktze.

Prairies, meadows, thickets, and glades or sandy open ground. Oxylophile. Southern and west-central Mo. and locally northwestward in Livingston Co.: St. Francois, Bollinger, Cape Girardeau, Wayne, Scott, Dent, Oregon, Maries, Cass, Henry, Livingston, Bates, Lawrence, Jasper, Newton, and McDonald counties.

CICHORIUM INTYBUS L. Chicory.

Fields, pastures, and waste ground. Indifferent. General but commonest in eastern Mo.

Krigia virginica (L.) Willd. Dwarf Dandelion.

Rocky open ground, glades, and fallow fields. Oxylophile. Eastern and southern Mo.: Montgomery, Lincoln, Jefferson, St. Francois, Ste. Genevieve, Madison, Wayne, Iron, Gasconade, Texas, Polk, Henry, Greene, Ozark, Lawrence, Jasper, Newton, and McDonald counties.

Krigia biflora (Walt.) Blake, Rh. **17**: 135. 1915.

Krigia amplexicaulis Nutt. (G).

Cynthia virginica (L.) D. Don (B & B), in part.

Rocky open woods, low ground along streams, thickets, and prairies. Circumneutral to oxylophile. General and common.

Krigia Dandelion (L.) Nutt.

Prairies, glades, borders of woods, sandy fields, and alluvial or low sandy woods. Oxylophile. Central and southern Mo.: Montgomery, St. Louis, Jefferson, Franklin, Washington, St. Francois, Ste. Genevieve, Madison, Bollinger, Crawford, Iron, Wayne, Ripley, Dunklin, Oregon, Reynolds, Dent, Carter, Gasconade, Shannon, Phelps, Maries, Pulaski, Texas, Laclede, Douglas, Howell, Henry, Polk, Cedar, Webster, Vernon, Greene, Jasper, Newton, and McDonald counties.

Krigia occidentalis Nutt.

Cymbia occidentalis (Nutt.) Standley (B & B).

Rocky open woods and glades. Oxylophile. Southwestern Mo.: Jasper and McDonald counties. This species has often been confused with *Krigia virginica* and *Serinia oppositifolia*.

PICRIS SPRENGERIANA Poir. See Bull. Mo. Bot. Gard. **19**: 121. 1931.

Waste ground. Introduced in St. Louis Co.

TRAGOPOGON PRATENSIS L. Goat's Beard.

Fields, meadows, and along roadsides and railroads. Indifferent. General: Lincoln, St. Charles, St. Louis, Jefferson, St. Francois, Madison, Maries, Schuyler, Adair, Mercer, Daviess, Laclede, Atchison, Nodaway, and Platte counties, and spreading state-wide.

TRAGOPOGON PORRIFOLIUS L. Vegetable Oyster, Salsify.

Fields and waste ground. Escaped from cultivation. Indifferent. Scattered: Boone, St. Louis, Pulaski, Camden, and Jackson counties.

TARAXACUM PALUSTRE (Lyons) Lam. & DC. var. VULGARE (Lam.) Fernald, Rh. **35**: 380. 1933. Dandelion.

Taraxacum officinale Weber (G).

Leontodon Taraxacum L. (B & B).

Fields and waste ground; common about dwellings. Indifferent. General.

TARAXACUM LAEVIGATUM (Willd.) DC. See Rh. **35**: 379. 1933. Red-seeded Dandelion.

Taraxacum erythrospermum Andrz. (G).

Leontodon erythrospermum (Andrz.) Britton (B & B).

Fields and waste ground about dwellings. Indifferent. General.

Crepis setosa Hall. Hawk's Beard.
Fields and waste ground. Introduced in Boone Co.

CREPIS CAPILLARIS (L.) Wallr.
Open ground. Introduced in St. Louis Co.

SONCHUS ARVENSIS L. Sow Thistle.
Waste ground. Indifferent. Introduced in Jackson Co.

SONCHUS OLERACEUS L. Common Sow Thistle.
Fields and waste ground. Indifferent. General.

SONCHUS ASPER (L.) Hill.
Fields and waste ground. Indifferent. General.

LACTUCA SALIGNA L.
Roadsides and waste ground. Indifferent. Scattered: Marion, Pike, Monroe, St. Louis, Maries, Phelps, Pulaski, Laclede, Saline, Pettis, Dallas, Wright, Webster, Douglas, Greene, and Barry counties.

LACTUCA SCARIOLA L. Prickly Wild Lettuce.
Roadsides and waste ground. Indifferent. General.

LACTUCA SCARIOLA var. INTEGRATA Gren. & Godr.
Commonly found with the typical form. General.

Lactuca canadensis L. var. **typica** Wiegand, Rh. **22**: 10. 1920.
L. canadensis L., in part (G), (B & B).
Fields, thickets, and waste ground. Indifferent. General but scattered.

Lactuca canadensis var. **latifolia** Ktze.
Occasionally found with the typical form. Scattered: St. Charles, St. Louis, Jefferson, Boone, Clinton, and Jasper counties.

Lactuca canadensis var. **latifolia** f. **exauriculata** Wiegand, Rh. **22**: 11. 1920.
Sometimes found with the typical and other varieties. Scattered: St. Francois, Howell, and Hickory counties.

Lactuca canadensis var. **integrifolia** (Bigel.) T. & G.
Lactuca sagittifolia Ell. (G), (B & B).
Lactuca canadensis var. *montana* Britton (B & B).
Thickets and waste ground. Indifferent. General but scattered: Boone, St. Louis, Dunklin, Jackson, Henry, and Jasper counties.

Lactuca canadensis var. **integrifolia** f. **angustata** Wiegand, Rh. **22**: 11. 1920.
Occasionally found with the other forms. St. Louis Co.

Lactuca canadensis var. **obovata** Wiegand, Rh. **22**: 11. 1920.
Lactuca integrifolia of auth., not Bigel. (G).
Thickets, fields and waste ground. Scattered: St. Louis, Ste. Genevieve, Mississippi, Boone, Jackson, and Taney counties.

Lactuca canadensis var. **obovata** f. **stenopoda** Wiegand, Rh. **22**: 11. 1920.
Occasionally occurring with the variety. Lincoln Co.

Lactuca ludoviciana (Nutt.) Riddell.
Plains and waste ground. Circumneutral. Northwestern Mo.: Atchison Co.

Lactuca hirsuta Muhl.
Dry open woods and waste ground. Circumneutral. Southwestern Mo., local: Jasper Co.

Lactuca villosa Jacq.
Open woods and thickets. Circumneutral. General.

Lactuca pulchella (Pursh) DC.
Moist open ground and loess hills. Calciphile. Western Mo.: Atchison and Jackson counties.

Lactuca floridana (L.) Gaertn.
Open woods and thickets. Circumneutral. General.

Lactuca graminifolia Michx.
Introduced along railroads. Butler Co.

Lygodesmia juncea (Pursh) D. Don.
Loess hills. Calciphile. Northwestern Mo.: Atchison, Holt, and Buchanan counties.

Agoseris cuspidata (Pursh) Steud.
Prairies and glades. Calciphile. West-central Mo., local: Jackson Co.

Pyrrhopappus carolinianus (Walt.) DC. False Dandelion.
Prairies, fields, and waste ground. Circumneutral. General.

Prenanthes altissima L. var. **cinnamomea** Fernald.
Rocky woods and bluffs. Circumneutral. Eastern and middle Missouri, mostly in the eastern Ozark region: Boone, Warren, St. Louis, Jefferson, Ste. Genevieve, Wayne, Iron, Dunklin, Carter, Shannon, Texas, and Ozark counties.

Prenanthes alba L. Rattlesnake-root, White Snake-root.
Rich or rocky woods. Circumneutral to oxylophile. Eastern Mo.: Clark, Marion, St. Louis, Franklin, and Gasconade counties.

Prenanthes aspera Michx.
Rocky open woods and prairies. Circumneutral. General but scattered.

Prenanthes crepidinea Michx.
Open woods and thickets. Circumneutral. East-central and southern Mo.: Audrain, Boone, St. Louis, Washington, Wayne, Greene, and Taney counties.

Hieracium scabrum Michx. Hawkweed.
Rocky woods and thickets. Oxylophile. Eastern, middle, and southern Mo.: Adair, Boone, Callaway, Lincoln, St. Louis, Jefferson, St. Francois, Ste. Genevieve, Scott, Iron, Reynolds, Shannon, Dent, Wright, Greene, Stone, Jasper, and Newton counties.

Hieracium Gronovii L. See Rh. **37**: 185. 1935.
Rocky open woods, thickets, and fields. Oxylophile. General. Several forms of this species have been confused with both *Hieracium venosum* and *Hieracium Traillii* (*Hieracium Greenii*) neither of which occur in Missouri.

Hieracium Gronovii var. **foliosum** Michx. See Rh. **37**: 185. 1935.
Similar situations to the preceding. Oxylophile. Scattered in eastern, central, and southern Mo.: St. Louis, Jefferson, Shannon, Phelps, Ozark, Jasper, and Marion counties.

Hieracium longipilum Torr.
Rocky open woods and prairies. Oxylophile. Eastern, central, and southern Mo.: Marion, Boone, Callaway, Iron, Reynolds, Dent, Shannon, Texas, Morgan, Henry, Hickory, Polk, Greene, Howell, Vernon, Barton, Jasper, and Newton counties.

Tabular List of Families

Families	Genera		Species		Varieties		Forms		Hybrids
	Native	Introd.	Native	Introd.	Native	Introd.	Native	Introd.	
SPERMATOPHYTA									
GYMNOSPERMAE									
Pinaceae	3		4	2	1				
ANGIOSPERMAE									
MONOCOTYLEDONEAE									
Typhaceae	1		2						
Sparganiaceae	1		3						
Najadaceae	4		11	1	4				
Alismaceae	5		13		3		1		
Hydrocharitaceae	2		2						
Gramineae	59	13	177	51	40	5	7	1	
Cyperaceae	12		166		22				
Araceae	3		4				1		
Lemnaceae	4		9		1				
Commelinaceae	2		13		1				
Xyridaceae	1		1						
Pontederiaceae	3		5						
Juncaceae	2		18		6		1		
Liliaceae	18	5	39	9	5		3		
Dioscoreaceae	1		2		1				
Amaryllidaceae	3	1	3	1	1		1		
Iridaceae	3	1	9	4	1				
Marantaceae	1		1						
Orchidaceae	14		27		3				
DICOTYLEDONEAE									
Piperaceae	1		1						
Salicaceae	2		14	5	4	3	1		8
Leitneriaceae	1		1						
Juglandaceae	2		10		8		3		
Betulaceae	5		6		2		1		
Fagaceae	3		23		8		3		16
Ulmaceae	3		8		5				
Moraceae	3	2	3	4					
Urticaceae	5		7	1					
Santalaceae	1		1						
Loranthaceae	1		1						
Aristolochiaceae	2		2		3				
Polygonaceae	5	1	31	11	6	1	1		1
Chenopodiaceae	7	2	19	13	8	3	4	2	1
Amaranthaceae	5		9	4	3	1			
Phytolaccaceae	1		1						
Nyctaginaceae	1		5		1				
Illecebraceae	1		2						
Aizoaceae	1	1	1	1					

TABULAR LIST OF FAMILIES (Continued)

Families	Genera		Species		Varieties		Forms		Hybrids
	Native	Introd.	Native	Introd.	Native	Introd.	Native	Introd.	
Caryophyllaceae	5	5	11	16	4	1			1
Portulacaceae	3		6	2			1		
Ceratophyllaceae	1		1						
Nymphaeaceae	5		7	1					
Ranunculaceae	14		41	4	5		6		
Magnoliaceae	2		2		1				
Annonaceae	1		1						
Menispermaceae	3		3						
Berberidaceae	3		3	2					
Lauraceae	2		2		2				
Papaveraceae	3	2	5	4	1				
Fumariaceae	2		7		1				
Cruciferae	13	12	30	29	5	1			
Capparidaceae	2		3	1					
Crassulaceae	2		4	1					
Saxifragaceae	8		15		4		3		
Hamamelidaceae	2		3				2		
Platanaceae	1		1		1		1		
Rosaceae	15	2	111	14	48		6		3
Leguminosae	36	4	96	23	24		1		2
Oxalidaceae	1		4		5		4		
Geraniaceae	1	1	3	1	1				
Linaceae	1		4	1					
Zygophyllaceae	1	1	1	1					
Rutaceae	2	1	2	1					
Simarubaceae		1		1					
Polygalaceae	1		4		3				
Euphorbiaceae	7	2	26	3	2				
Callitrichaceae	1		1		1				
Anacardiaceae	2		6		2				
Aquifoliaceae	1		2		1				
Celastraceae	2		4						
Staphyleaceae	1		1						
Aceraceae	1		6		8		2		
Sapindaceae	1	1	1	1					
Hippocastanaceae	1		2		4				
Balsaminaceae	1		2	1					
Rhamnaceae	3		5	1	2				
Vitaceae	4		13		7				
Tiliaceae	1		2		2				
Malvaceae	4	4	10	10		1			
Hypericaceae	2		14	1					
Elatinaceae	2		2						
Tamaricaceae		1		1					
Cistaceae	2		3						
Violaceae	2		17	1	3				9

Tabular List of Families (Continued)

Families	Genera		Species		Varieties		Forms		Hybrids
	Native	Introd.	Native	Introd.	Native	Introd.	Native	Introd.	
Passifloraceae	1		2						
Loasaceae	1		1						
Cactaceae	2		2		1				
Thymelaeaceae	1		1						
Elaeagnaceae		1		1					
Lythraceae	5		5	1	1				
Melastomaceae	1		2		1				
Onagraceae	7		27		3				
Haloragidaceae	2		3	1	2				
Araliaceae	2		3						
Umbelliferae	23	9	32	10	5				
Cornaceae	2		8				1		
Ericaceae	3		6		6				
Primulaceae	7	1	10	2	2	1			
Sapotaceae	1		2						
Ebenaceae	1		1		2		1		
Styracaceae	1		1						
Oleaceae	3		7		3				
Loganiaceae	2		2						
Gentianaceae	4	1	9	1	1				
Apocynaceae	3	1	7	1	7				
Asclepiadaceae	5		21		3		1		
Convolvulaceae	4		13	6	5	1			
Polemoniaceae	4		7		7		1		
Hydrophyllaceae	5		10						
Boraginaceae	8	2	13	7	4				
Verbenaceae	2		8		1				4
Labiatae	18	6	49	18	14	1	2		
Solanaceae	2	5	19	10	3				
Scrophulariaceae	21	3	44	8	11		2		1
Lentibulariaceae	1		1		1				
Orobanchaceae	2		2						
Bignoniaceae	3		4						
Pedaliaceae		1		1					
Martyniaceae	1		1						
Acanthaceae	3		6		1				
Phrymaceae	1		1						
Plantaginaceae	1		10	1					
Rubiaceae	7		23		4				
Caprifoliaceae	5		15	1	6		1		
Valerianaceae	1		3		1				
Dipsacaceae		1		1					
Cucurbitaceae	5		5						
Campanulaceae	2		5	1					
Lobeliaceae	1		6		1				
Compositae	65	15	243	35	71	5	7		15

SUMMARY BY DIVISIONS AND CLASSES

	Genera		Species		Varieties		Forms		Hybrids
	Native	Introd.	Native	Introd.	Native	Introd.	Native	Introd.	
Pteridophyta	26		52		13		5		
Spermatophyta	850	109	1785	336	442	24	69	4	60
Gymnospermae	3		4	2	1				
Angiospermae	847	109	1781	334	441	24	69	4	
Monocotyledoneae	139	20	509	68	89	5	14	1	
Dicotyledoneae	708	89	1272	266	352	19	55	3	60

SUMMARY BY MINOR GROUPS

Families 131

Genera

Native 876
Introduced 109
Total 985

Species

Native 1837
Introduced 336
Total 2173

Varieties

Native 455
Introduced 24
Total 479

Forms

Native 74
Introduced 4
Total 78

Hybrids 60

Total number of plants (species, varieties, forms, and hybrids) 2790

Of the 479 varieties listed 108 (such as *Utricularia vulgaris* var. *americana, Lonicera dioica* var. *glaucescens*) should be more properly counted in with the regular species, since they are the only representatives of particular species in the flora. This would bring the total number of species up to 2,281.

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Valid names of plants in ordinary Roman type, synonyms or otherwise invalid names in *italics,* new species varieties, forms, hybrids, and new combinations in **bold face,** and family names in Roman capitals.

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Explanation of Plate

PLATE 15

Fig. 1. St. Francis River, Wayne Co., showing gravel bars typical of many Ozark streams, and deciduous oak-hickory forest on granitic substratum.

Fig. 2. Dolomite bluffs of the White River, Barry Co., with *Juniperus mexicana* near top and rich talus slope below.

Fig. 3. Mississippian limestone with interbedded chert, the latter producing acid soils when left as a surface deposit after erosion and solution of the limestone, Jasper Co.

Fig. 4. Erosion in loess, Clark Co.

Fig. 5. Porphyry ''shut-in'' along Little St. Francis River, Madison Co., showing *Pinus echinata* along stream course.

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PALMER & STEYERMARK—PLANTS OF MISSOURI

Explanation of Plate

PLATE 16

Fig. 1. Bald knobs, Ozark Co., showing the advance of the forest upon the glades.

Fig. 2. Porphyritic trachyte glade, summit of Hughes Mountain, St. Francois Co., showing weathering of the formation into block-like structures.

Fig. 3. Grand Falls chert glades, Newton Co., habitat of several southwestern species not found elsewhere in the state.

Fig. 4. St. Peter sandstone glade with *Juniperus virginiana* and deciduous forest along margin, Jefferson Co.

Fig. 5. Porphyritic trachyte glade, typical of the Iron Mountain area in the eastern Ozarks, Hughes Mountain, St. Francois Co.

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PALMER & STEYERMARK—PLANTS OF MISSOURI

Explanation of Plate

PLATE 17

Fig. 1. La Motte sandstone bluff in wooded ravine, Ste. Genevieve Co., western limit of a number of eastern and Appalachian species.

Fig. 2. St. Peter sandstone bluff with slough at base, Jefferson Co.

Fig. 3. Porphyritic trachyte "shut-in" along Little St. Francis River, Madison Co., with forest of *Pinus echinata* on slopes.

Fig. 4. La Motte sandstone bluffs with *Pinus echinata* above, Ste. Genevieve Co.

Fig. 5. Sandstone outcrops on high prairies, Jasper Co., locality for *Geocarpon minimum* and other rare species.

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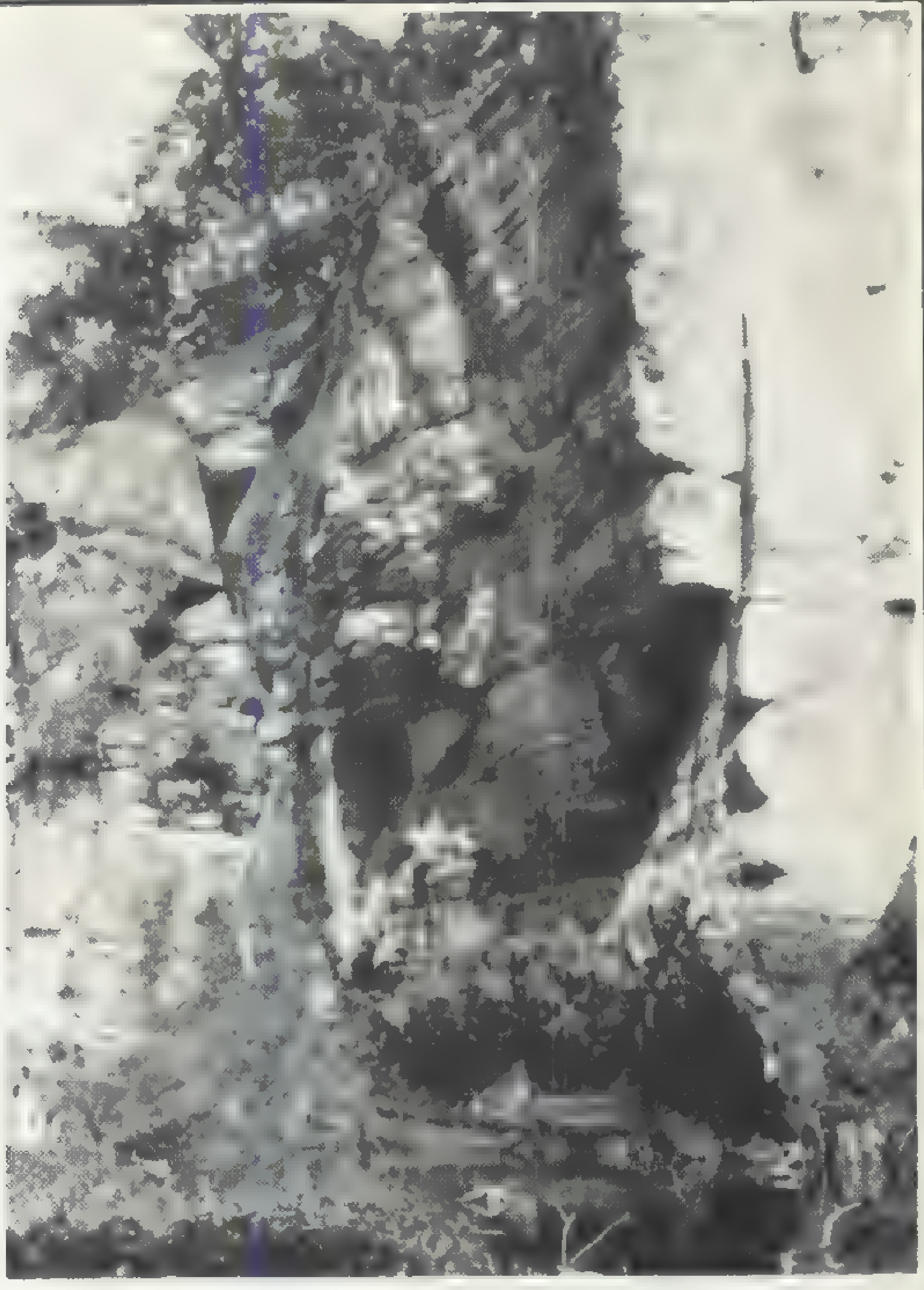

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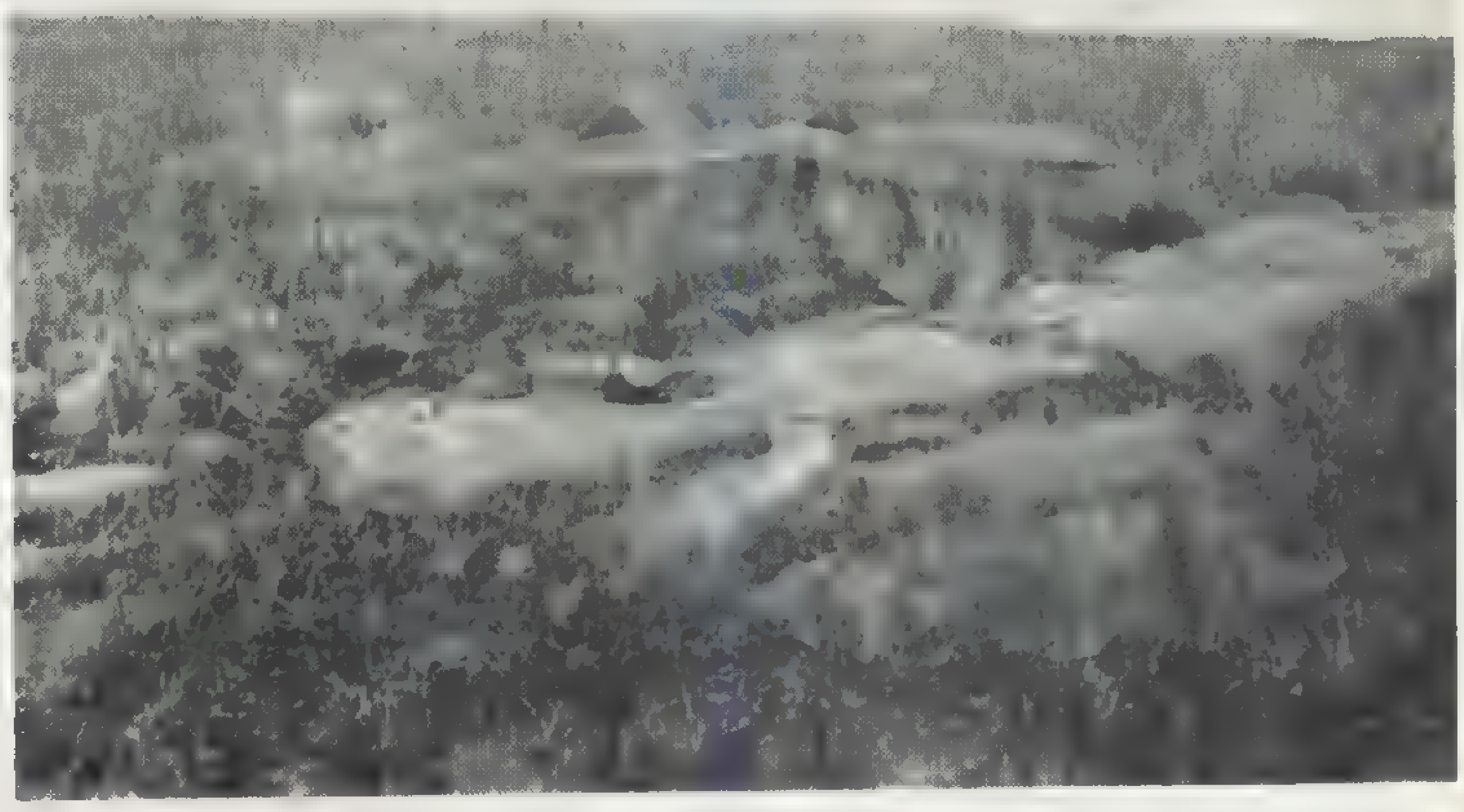

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PALMER & STEYERMARK—PLANTS OF MISSOURI

Explanation of Plate

PLATE 18

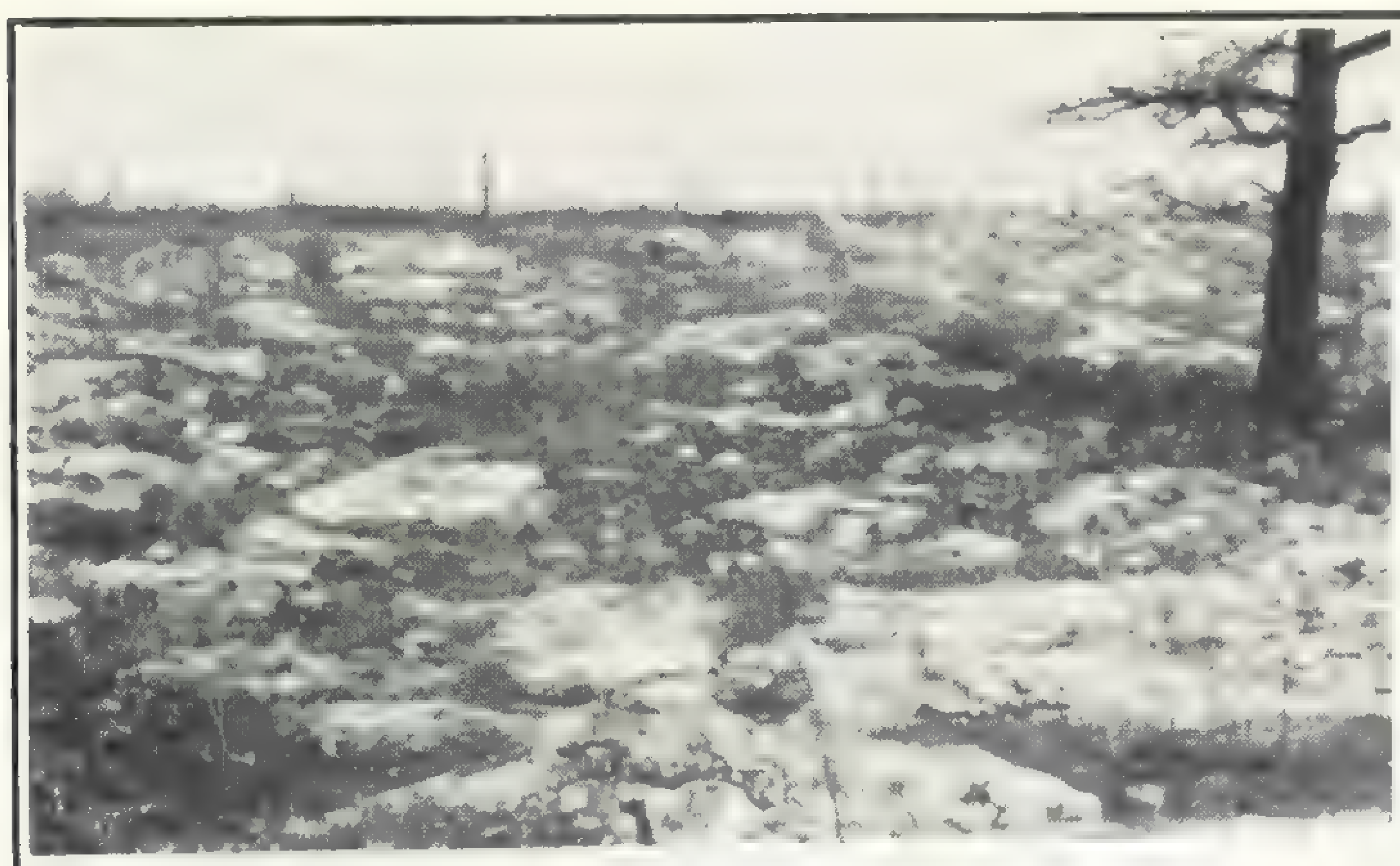
Fig. 1. Chert glades, outcrops of Grand Falls chert, Jasper Co.

Fig. 2. Dolomite ledges near top of bald knob, with *Delphinium Treleasei*, Barry Co.

Fig. 3. Loess mounds, Holt Co., showing high plains and prairie vegetation on exposed ridges and slopes, and beginnings of forest in depressions and ravines. A good example of the influence of exposure to winds and evaporation on floral formations.

Fig. 4. Alluvial bottoms of Missouri River, with lake in distance and loess mounds on sky-line in background, Holt Co.

Fig. 5. Glaciated prairies topography, Schuyler Co.



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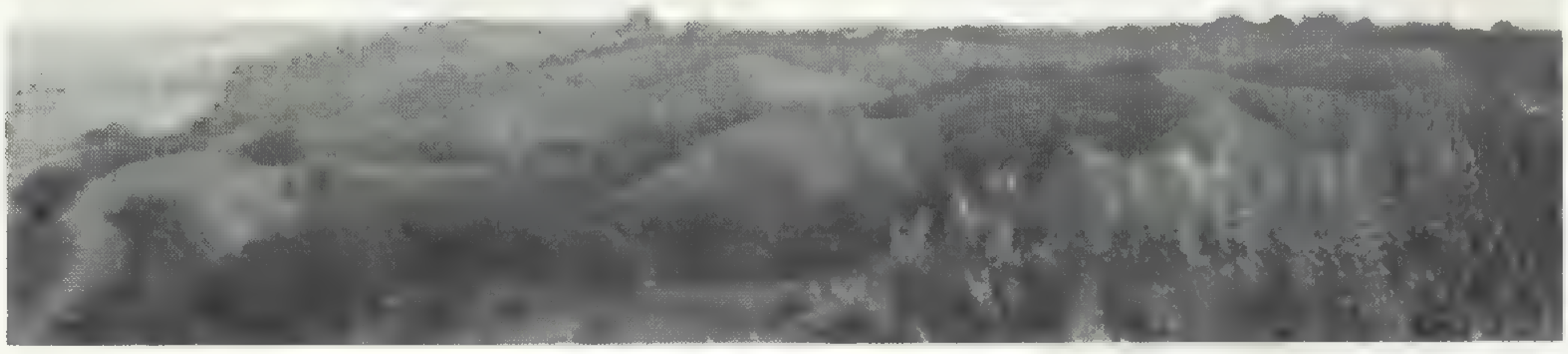

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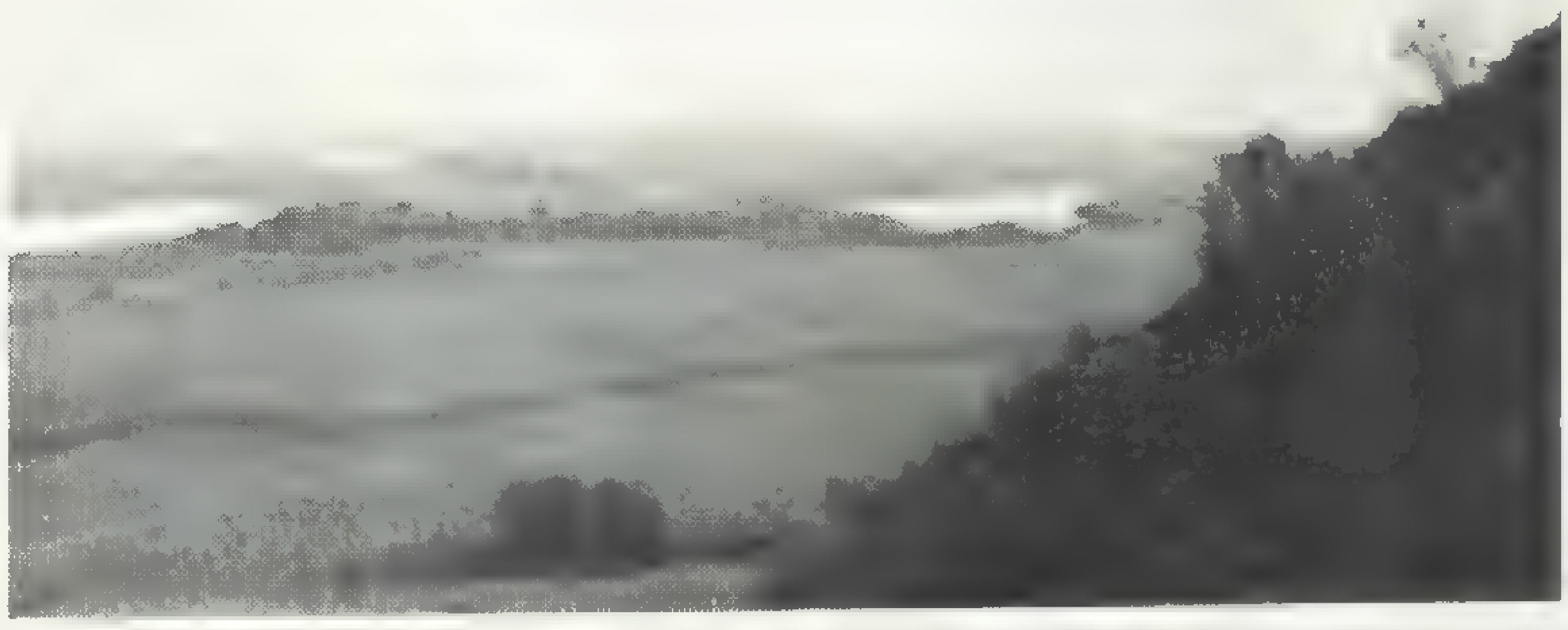

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PALMER & STEYERMARK—PLANTS OF MISSOURI

Explanation of Plate

PLATE 19

Fig. 1. Densely forested country typical of the Ozark region near the influence of streams, and showing accordant levels of hills carved by erosion from old peneplain, Shannon Co.

Fig. 2. Butler Bluff, McDonald Co., locality for *Cheilanthes alabamensis* and other southwestern species.

Fig. 3. Porphyritic trachyte bluffs of "shut-in" near mouth of Little St. Francis River, Madison Co.

Fig. 4. Limestone glade (Joachim limestone), Jefferson Co., with typical development of *Juniperus virginiana* in background and clumps of *Clematis Fremontii* on exposed portions.

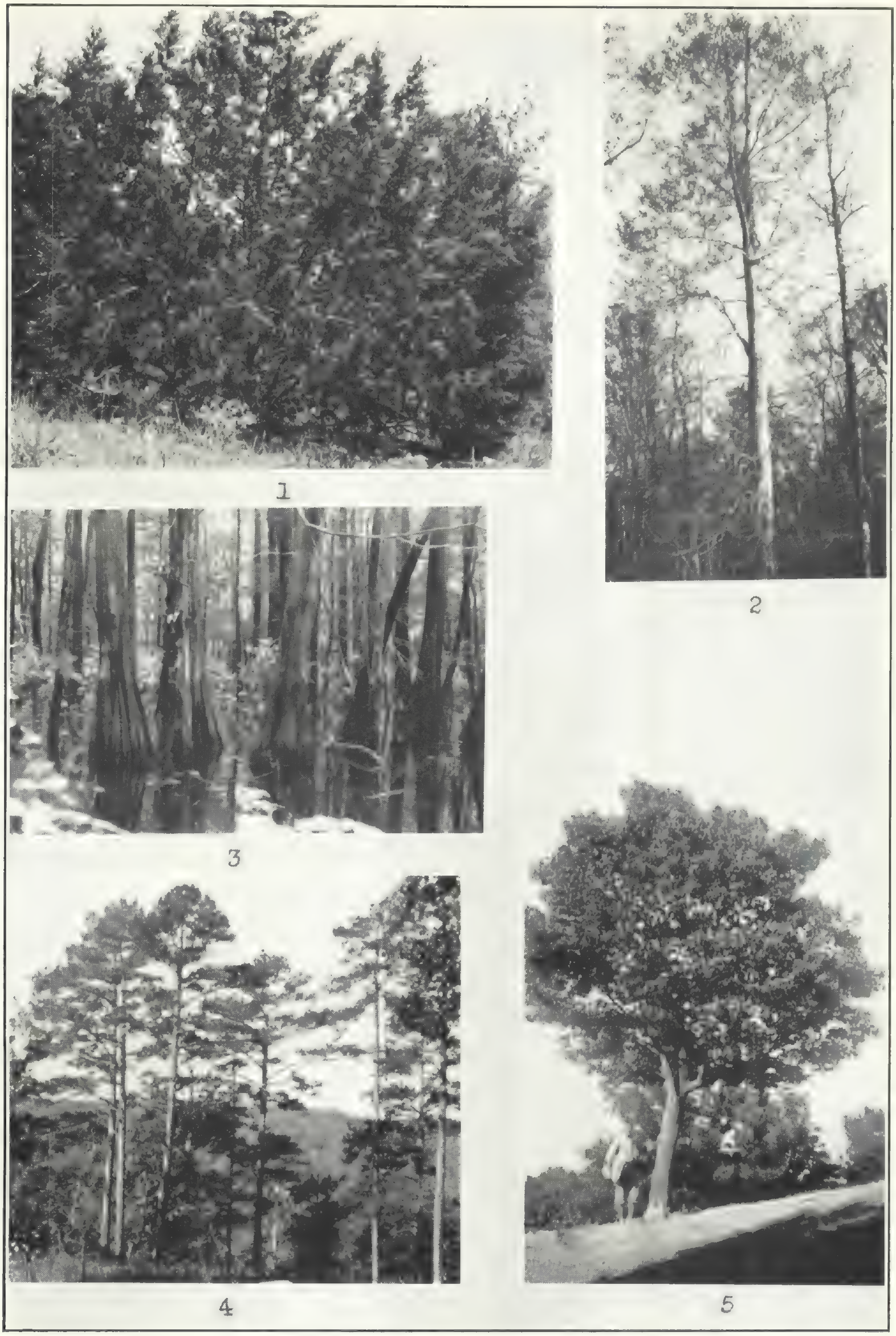
Fig. 5. "Shut-in" along Little St. Francis River, Madison Co., typical of the Iron Mountain area of igneous rocks in the eastern Ozark region where a number of eastern and Appalachian species, such as *Hamamelis virginiana*, *Ilex verticillata* var. *padifolia*, *Rhododendron nudiflorum* var. *roseum*, and *Pedicularis lanceolata*, are found.

PALMER & STEYERMARK—PLANTS OF MISSOURI

Explanation of Plate

PLATE 20

Fig. 1. *Juniperus mexicana*, on bald knobs along White River, Barry Co.
Fig. 2. *Fagus grandifolia* var. *caroliniana*, in low woods, Butler Co.
Fig. 3. *Taxodium distichum*, in swampy woods, Mississippi Co.
Fig. 4. *Pinus echinata*, Shannon Co.
Fig. 5. *Amelanchier canadensis* (large tree form), Schuyler Co.



PALMER & STEYERMARK—PLANTS OF MISSOURI

Explanation of Plate

PLATE 21

Fig. 1. *Rhododendron nudiflorum* var. *roseum*, on wooded granitic slope, Madison Co., southeastern Ozark region.

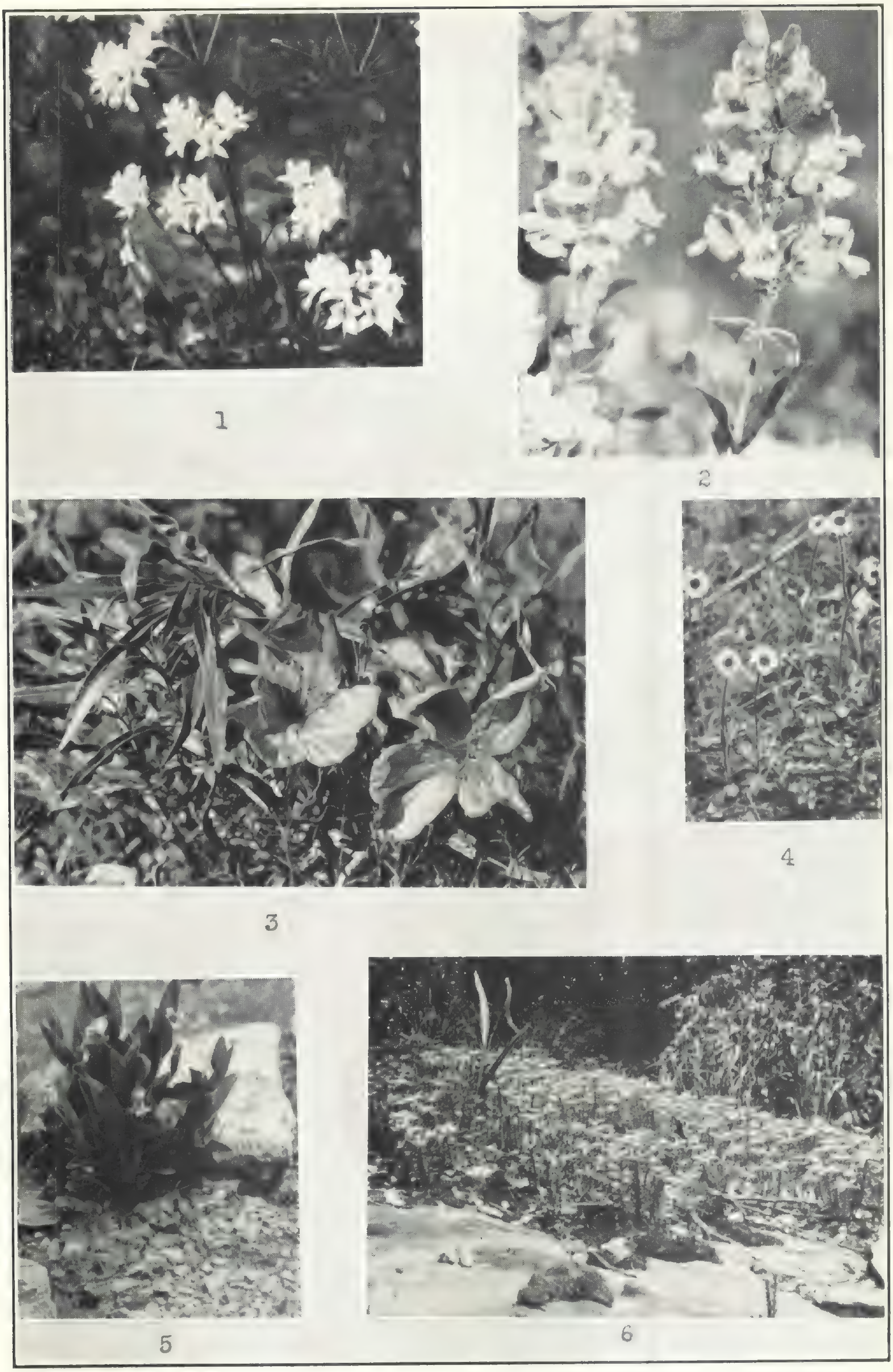
Fig. 2. *Pentstemon Cobaea* var. *purpureus*, on bald knobs, Taney Co.

Fig. 3. *Oenothera missourensis*, on bald knobs, Barry Co.

Fig. 4. *Erigeron pulchellus*, in open woods, Jefferson Co.

Fig. 5. *Clematis Fremontii*, in limestone glade, Jefferson Co.

Fig. 6. *Sedum pulchellum*, in limestone glade, Jasper Co.



PALMER & STEYERMARK—PLANTS OF MISSOURI

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THE REACTIONS OF PLANTS TO ULTRA-VIOLET

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GENERAL CONSIDERATIONS

It has been recognized for a considerable time that in general, as Ellis and Wells ('25) observe, there are two effects of ultra-violet radiations upon organisms, designated as stimulative and lethal, with the dividing line approximately at 2900 Å. If, however, various types of organisms and their different functions are considered separately both the exact significance of these terms and the limits of the regions concerned must be defined more explicitly. In addition, the numerous environmental factors so modify the effects of any one of them that unless the conditions are exactly stated there is a conflict of results such as has been emphasized by Popp and Brown ('33). It must be recognized, however, that such conflict of results is due to the different conditions under which the experiments have been carried on, the differences in physiologic action of various combinations of ultra-violet regions, and the specificity of organisms, rather than to a non-responsiveness of plants to ultra-violet.

The terms "stimulative" and "lethal" must be defined in relation to definite standards, and when we are dealing with a complex organism and especially with one of our higher plants

which is not so completely integrated as are the higher animals, we must recognize that these terms may be applied either to the whole organism or to one or more of its parts or functions. As is well known, the lack of a proper amount of light results in the etiolation of green plants. Under such conditions the use of ultra-violet irradiation cannot be expected to give a stimulation which will reveal itself in greater elongation. In fact the opposite result, as might be expected from the known action of the violet end of the spectrum, actually occurs. Under conditions of reduced visual illumination tomato plants irradiated with the mercury arc are shorter than those which are unirradiated, although with a moderate amount of irradiation from the mercury arc the dry weight of tissue produced may be the same as in the somewhat etiolated, unirradiated plants (table 1). More strongly irradiated plants under the same conditions develop less tissue as determined by its dry weight, and correlated with this reduced vegatative growth there may be much more abundant formation of green fruit.

TABLE I

REACTION OF TOMATO PLANTS TO ULTRA-VIOLET IRRADIATION UNDER REDUCED VISIBLE ILLUMINATION

	Set A*	Set B*	Set C*
Average increase in height in 2 months	28.9 cm.	21.6 cm.	20.9 cm.
Average dry weight	0.73 gm.	0.71 gm.	0.57 gm.
Weight of green fruit produced	(26 plants) 26.3 gms.	(26 plants) 23.1 gms.	(20 plants) 55.7 gms.

* Set A (30 plants) unirradiated controls. Set B (29 plants) and C (21 plants), irradiated at 50 inches from the mercury vapor arc through a water filter of Vita glass, 9 minutes and 18 minutes daily, respectively.

Thus it is evident that the action of ultra-violet on these plants may result at the same time in reduction of elongation and in an increase in fruit formation. On the other hand, a reduction in the amount of ultra-violet attained by increasing air absorption through greater distance, concurrent with a

more normal amount of visible illumination as evidenced by lack of etiolation in checks, results in actual increase in dry weight, elongation, and mineral content (Fuller, '31). Similar results have been obtained in other series of experiments in our laboratory more recently and have also been reported by others (Benedict, '34), all of which indicate clearly that the criteria of "stimulation" and "injury" vary with the species and with the different conditions under which they are studied. We cannot determine at the present time how much of the effect is due to direct action and how much to indirect. Thus it is probable that the greater fruit formation in plants showing strongly retarded vegetative growth is due largely to the disturbed nutritional balances as may be inferred from the work of Kraus and Kraybill ('18), Murneek ('26), and Harvey ('31), yet some direct stimulation is possible. As will be demonstrated in later papers in this series, various phases of respirational activities react differently to the same ultra-violet regions. Enzymic activity may be stimulated as shown by Fuller ('32), v. Euler and Günther ('33), Bersin ('33), and from studies to be reported in a later paper in this series, and this may occur when there is coincident evidence of injury to other systems.

It is especially important therefore to examine the applications of our criteria in order to avoid much needless discussion of results based upon uncertainty in their use and to determine the conclusions which may properly be drawn. In the study of the effects of radiations upon organisms many indefinite factors exist, not the least of which is the variety of material used in the experiments. It is now well understood that while there are certain broad fundamental ways in which all green plants are similar in their physiology, yet each species and variety has a physiology of its own both qualitatively and quantitatively different from that of any other. We do not know as yet the experimental limits of this specificity in any given case except as expressed in the general results which give us the indistinct concept of the species. This one variable factor has given rise to many pages of useless discussion in the papers

on radiations. To expect all plants to respond uniformly to such a complex environmental factor as ultra-violet is to ignore their specific character as well as the specific action of different types and quantities of energy.

Another general factor which frequently is forgotten is the historical, evolutionary development of the plant kingdom. The physical concept of a smooth cumulative curve of effects from a given kind of force, such as increasing heat causing an increasing expansion of an iron bar, has restricted value when applied to plants. They have been subjected through eons of time to circumscribed ranges or intensities of certain physical and chemical conditions to which they have become adjusted. Therefore in subjecting them experimentally to the entire range of a given force we should expect them to respond in one manner in the range to which they have become adjusted and in another manner in the ranges outside of their historical experience. Thus we find that within a certain restricted range of temperature most plants increase in size in a direct ratio to increased temperature, while outside of this range they react quite differently. It is necessary of course to take into consideration in such a statement a certain elastic adaptability which enables living organisms to extend their responses somewhat normally even beyond the usual range of the physical factors. These two variables, plant specificity and specific adjusted reaction to certain ranges of each environmental factor, are probably more important in influencing attempts to obtain generalizations than many other factors which have been so greatly stressed by some.

As concerns growth related to any external stimulus, there are evidently three possible general conditions: (1) it may be definitely increased over that under established standards due to dominance of stimulative over retarding influences; (2) it may be definitely reduced below the established standards, due to dominance of retarding factors over stimulative ones; and (3) there may be such a balance of these two sets of effects that no significant increase or decrease can take place. It is possible also that in this last case certain physiological activities

which are not reflected in growth may be stimulated or retarded. From the above considerations it is clear that growth cannot be a complete index of stimulative or lethal reaction of plants.

In the field of radiations growth as a criterion of stimulation must be carefully defined. Size, wet weight, dry weight, and number of leaves must all be given careful consideration and balanced against one another, for no one of them can be used exclusively to indicate stimulation. In the phase of reproduction radiations are coming to be recognized as more and more important, and we expect that stimulation will be evidenced in the number, form, and size of the fruiting structures at times when vegetative features fail to give evidence of reaction. Occasionally the phrase "beneficial effects" (Popp and Brown, '33) is used more or less as synonymous with stimulation, but it is liable to have a subjective rather than an objective content, and a very careful assessing of the values of the various stimuli and of criteria must be made before it can have a quantitative value. Thus a stimulated growth may be beneficial under certain circumstances and stages of growth, but positively injurious at other times, while the reverse may also be true. Let us now consider some of the ways in which growth has been used as a criterion in radiation experiments on plants.

Experiments, such as those of Popp and Brown ('28), in which the early seedling stages have been used as a test for stimulation, can hardly be used as a proof against the concept of stimulation as applied to older plants. It is a well-known fact in general physiology that the physiology of the young organism is often quite different from that of the more mature individual. Moreover, the growth curve of an individual shows an exceedingly rapid rise during the early seedling stages, and it is doubtful whether at this time all stimulative factors could be expected to affect the rate of growth even if they could at a later, slower period. On the other hand, retarding and limiting factors may become especially effective during the period of normally active enlargement. Thus a small decrease in the water supply at such a time may have a much greater effect

than at a later stage and hence have a greater antagonistic action toward the tendencies of reaction to stimulative factors.

It is entirely probable that one of the reasons why growth is so active during the early seedling stages is that there is stored away in the seed a maximum amount of all sorts of food substances, including the vitamines, stimulative to rapid growth. As a seedling matures it tends to exhaust the stored supplies, or distribute them throughout more and more tissues, or remove them from further utilization by combining them in more or less stable, permanent compounds unless renewed by favorable physiological processes. If, as may well be, the stimulative action of ultra-violet radiations is due to the manufacture in the plant of stimulative compounds, some of which may be stored in the seed, adequate to the maximum stimulation of the developing seedling, the stimulative action of ultra-violet would not become manifest until after the essential exhaustion of the seed reserves. For a similar reason, if plants are growing under daylight conditions in which ultra-violet adequate to maximum stimulation for a given set of conditions has been supplied naturally, then additional raying from an artificial source would not be evidenced in stimulation. Hence experiments performed in one season of the year may not be at all comparable with those at another season, and likewise experiments under different aerial conditions such as arise from varying quantities of smoke, moisture, cloudiness, etc., cannot be fairly compared, nor equal value attached to negative results as to positive ones.

As illustrating the seasonal effects upon ultra-violet the following may be cited: In summer about 1 per cent of solar radiation is in the ultra-violet and about .04 per cent in the region 290 $m\mu$ to 320 $m\mu$. In winter the figures are .2 per cent total ultra-violet and .013 per cent in the region 290–320 $m\mu$ (Laurens, '33, p. 54). While these values were obtained for a different region than ours, comparisons of numerous other determinations indicate that these are fair approximations for many other regions.

It has been our common experience in this laboratory that even injury from irradiation by an unscreened mercury vapor

arc is much more difficult to demonstrate on tomato plants which have developed during the summer months in the greenhouse than upon those developed during the winter months. Older plants in the summer are likewise less easily injured by ultra-violet than younger ones. Some of these differences may no doubt be attributed to certain anatomical changes which occur in plants when rayed with ultra-violet such as described by Eltinge ('28).

From the various considerations just discussed it is evident that experiments showing lack of stimulation under ultra-violet cannot be used to condemn positive results unless it is certain that the other environmental and biological conditions have been duplicated. If one compares the investigations reporting lack of stimulation with those most carefully controlled which report stimulation (Fuller, '31; Benedict, '34), it is evident that no careful attempt has been made in the former to duplicate the conditions under which stimulation has taken place. It should be pointed out here that there is a decided difference in the conditions of irradiation between those in which there is given a long-time or close exposure of seeds, seedlings, and more mature plants to artificial irradiation sources and those in which short-time or long-distance exposures are made. Short injurious ultra-violet waves are much more fully absorbed by air than are the longer ultra-violet, and in short-time exposures the variable of visible light is eliminated in a practical manner and the variable of infra-red is also greatly reduced. Although both of these variables have been stressed recently (Popp and Brown, '33), as seriously influencing conclusions concerning the ultra-violet stimulation, it should be noted that there is a great difference between adding a little more visible light and some extra heat to the environment of a plant well supplied with these factors and adding ultra-violet to an environment almost devoid of such a factor. Shirley ('29), for example, records that the rise in temperature due to the heat from his 1500-watt lamps at 24 inches distance was less than 0.5° C., while Fuller's lamp was at 100 inches and a large electric fan was constantly used during irradiation to remove so far as possible any excess heating.

Since for all of the experiments reported from our laboratories the plants were grown in the winter or spring in the greenhouses, and much of the ultra-violet which is accepted as stimulative in character is screened out by greenhouse glass and reduced by climatic and seasonal conditions, it is evident that the plants would be in a condition to be stimulated by the ultra-violet from an artificial source. Such actual increased growth has been recorded in our laboratories for a variety of plants irradiated by a mercury vapor arc. Such distances and such screens were used as would remove injurious ultra-violet, and essentially eliminate the variables of added visible light and of infra-red since they constituted but a minute fraction, an average of nine minutes a day exposure, of the total of such energy received by the plants during the experimental growth period. In these experiments (Fuller, '31) where there were ten sets of one hundred plants each, both the wet weight and dry weight of all the sets rayed through filters which cut off the injurious ultra-violet were significantly greater than those of the unrayed controls. In six out of the eight rayed sets also significant increases in height occurred.

The pertinent question may be raised as to how one may explain the stimulative action of small amounts of ultra-violet on organisms when we are inclined to discount the larger amounts of visible and infra-red radiations from the same artificial source. It is rather generally accepted that within certain limits growth increases quantitatively with light and heat. On the other hand, the changes in plants caused by ultra-violet seem to be qualitatively different from those caused by other radiations (Jacobi, '28) and certainly cannot be estimated in terms of the quantity of energy available in the ultra-violet compared with that present in visible and infra-red radiations. Or we may say that a small quantity of energy added experimentally is more effective in this range of radiations than in the others, due perhaps to a more complete absorption and to the fact that the amount of ultra-violet added is proportionately very large during winter and early spring. Whether, as has been suggested (Laurens, '33), these shorter

wave lengths cause special intimate molecular or atomic rearrangements we cannot at present know. It may be also that something akin to the rigor or tetanus produced in organisms by consecutive applications of stimuli might prevent stimulation in the presence of larger amounts of the same forces, but in the absence of natural ultra-violet of certain wave lengths an artificial application might be especially effective, particularly when added in successive, short doses. Johnston ('32) has recently used infra-red radiations in conjunction with light and found that when the latter was well below the optimum for tomato plants the near infra-red stimulated growth, but with a higher degree of illumination the infra-red stimulation was much less. This seems to indicate that stimulative action of the infra-red is much less effective as normal illumination is approached.

In conclusion we may summarize the discussion as follows: Physiological response includes both increased and decreased activities. Growth is a resultant of numerous physical and chemical reactions. Stimulation or increased growth may therefore be a resultant of some increases and some decreases of physical and chemical activities. Injury and retarded growth may indicate either a total resultant reaction of all the physical and chemical reactions or interference with some one or several specific reactions. Ultra-violet and X-radiations cannot be expected to affect every one of the numerous physical and chemical activities in an accelerative fashion or, on the other hand, all in a retarding fashion. Evidences are found all through the numerous studies on radiations to substantiate these statements. It is to be expected, therefore, that there will be numerous apparently contradictory results as long as growth alone is taken as a criterion for stimulation and interpreted as the result of purely quantitative applications of energy. This is especially true if the results from studies upon different species and varieties are massed together and compared. It is evident therefore that experimental studies which have failed to produce acceleration of growth cannot be used to impugn those which have demonstrated stimulation.

The element of critical surprise evidenced in Popp and Brown's ('33) summary of ultra-violet work, that such contradictory results are published, and the implication of untrustworthy data are not wholly justifiable in view of the considerations discussed above. We should expect just such a condition, and instead of attempting at the present time to amalgamate all such work into a consistent unit and to evaluate it in terms of uniformity of growth results, it would be more profitable to recognize the existence of numerous separate problems and allocate to each the data properly belonging to it. In some of the earlier work where only a reconnaissance of the field has been attempted conditions have not been completely controlled, and it is indeed true that in other studies unjustifiable deductions have been made, or poor technique has made the work essentially valueless as soon as more carefully controlled experiments are reported. Finally, the historical development of the plant kingdom has led to adjustments of plants to restricted ranges of environmental factors. Within these ranges any green plant will react quite differently than it will outside of them, and therefore even opposite reactions may be expected from the same plant in these different ranges, as, for example, stimulated growth in some radiations and retarded in others.

A series of investigations has therefore been initiated and is in progress in which separate physiological activities are being studied in relation to ultra-violet, in an effort to define the conditions under which stimulative and lethal actions occur.

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STUDIES IN ULTRA-VIOLET AND RESPIRATORY PHENOMENA. I[1]

Review of Work Published before June, 1935

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I. Introduction

The study of the relationships between ultra-violet light and biological materials has become enormously extended in recent years. The nature of the problems treated is so diverse that the field is already breaking up into smaller divisions, each of which is expanding so rapidly that it fully occupies the energies of students who wish to keep abreast of the developments. As soon as any field of research reaches these proportions, the need of critical reviews and extensive published bibliographies becomes increasingly apparent.

The present paper is a critical review covering the effect of ultra-violet radiation on respiration phenomena. It is scarcely possible that no paper has been overlooked, yet it is felt that the bibliography is essentially complete. Only papers giving data indicating the significant presence of ultra-violet light

have been included, and many studies on sunlight and on light from indefinite sources have not been mentioned.

Reviews of ultra-violet physiology containing material on respiratory phenomena have been published by Euler and Lindberg ('12), Pincussen ('21a, '30), Meyer ('26), Lippmann ('28), and by Laurens ('33), all of which are either outdated or inadequate. The best general review, especially from the viewpoint of biological theory, is that of Pincussen ('30), while the most recent work is that of Laurens, which, because of its wide scope, cannot give an adequate survey of all the pertinent literature.

II. Basal Metabolism of Animals

A. Lower Forms

Merker ('25a) was the first to report the respiratory activities of irradiated lower animal forms. In his earlier experiments he used a 1000-watt filament lamp, and although he makes no mention of ultra-violet rays, a light operating at such a wattage must have emitted a considerable amount of the longer ultra-violet. Merker was primarily interested in the problem of photosensitization by fluorescent substances. He treated living earthworms *(Lumbricus terrestris)* for several hours with a .001 per cent neutral-red solution, and then rayed them in a constant-temperature water bath. By determining the loss of dissolved oxygen from the water inhabited by the organisms, he calculated the oxygen consumption and found that it was markedly increased, but he concluded that the metabolic effects of the increased movement of the organisms when rayed could not be separated from the specific effect of irradiation. Later ('25b) he repeated these experiments with *Allolobophora caliginosa,* but extended the period of irradiation to 6 hours. An increased use of oxygen was evident for the first 200 minutes, after which there was a decrease. These worms lived until the next day, but showed definite injury. In yet another publication ('25d) these results are duplicated, and in the following year ('26) apparently the identical data were republished.

These papers were followed by another (Merker and Braunig, '27), which reported the results of raying a number of species of moist-skinned animals with the quartz mercury arc at a distance of 18.5 cm., for various periods. Both *Allolobophora* and *Lumbricus*, which were rayed for about 20 minutes, showed a decided decrease in oxygen use, and the raying of *Gammarus pulex* L., a swimming amphipod crustacean, for 54 minutes resulted in a very great decrease. In all cases of injury to the oxygen consumption, the termination of the irradiation allowed the return to about the normal rate. This return to normality was temporary, showing that the organisms had been permanently injured. Studies with filters showed that the injurious region was between 3660 Å and 3840 Å and that red light, 7800 Å to 6500 Å, had no effect.

Merker's experiments were not subject to definite interpretation because the organisms were stimulated to active movement, but this difficulty was satisfactorily met by Sonne ('26, '29). He used the pupae of meal worms, which show no movement when irradiated and have no disturbing food factors. In his earlier paper, he reports that the unscreened mercury arc produced a 40 per cent increase of oxygen use with an exposure of 45 minutes, and that the pupae turned black and died in a few days. Pupae rayed under a glass filter or through solutions of methylene-blue or potassium bichromate apparently were uninjured, although the oxygen stimulation was 20, 10, and 0 per cent, respectively. The respiration of excised tissues responded to heat, as did living tissue, but there was no response to irradiation. Sonne concluded that the action of light must depend on the presence of nervous and vascular tracts, and hence he made the unwarranted assumption that mineral metabolism must have been concerned in some way.

This work was carefully repeated three years later. The pupae rested on a thermo-needle which indicated any rise in temperature during the raying. The temperature of the water bath was so varied that no significant temperature change occurred in the organism. The open flame of a Kromayer lamp was used, as well as various filters, the irradiation lasting 30 minutes to 1 hour. The full arc gave a 40 per cent increase in

the oxygen uptake, a blue filter gave a 10 per cent increase, and a glass filter passing the visible and near ultra-violet gave an increase of 20 per cent. Sonne ('29) stated again that an increase in metabolism must bear some relation to the beneficial effects of raying on mineral metabolism. There is no evidence to support this assumption, for, as will be shown later, there is no undoubted metabolic change of human patients when rayed with the usual therapeutic doses.

Wickwire and Burge ('27) studied the effect of irradiation on the sugar assimilation of *Paramecium caudatum.* They used a Cooper-Hewitt mercury arc, operating on 170 volts and 3.5 amperes. Five cc. of the washed and centrifuged organisms were added to 100 cc. of a .1 per cent solution of dextrose, levulose, or galactose. The suspensions were rayed for 10 hours at various distances, after which the amount of sugar remaining in the solution was determined. When the raying was carried out at a distance of 50 cm., all the cells were killed and the sugar use was lowered 80 per cent. When rayed at 400 cm., the lowering was 35 to 40 per cent. In the latter instance, the cells were as active as the controls and appeared to be uninjured. In view of the fact that the activity of insulin is destroyed by ultra-violet light, these authors added insulin periodically to the solution and found that the lowering of the sugar use was prevented. It was concluded that the ultra-violet light affected the Paramecia by destroying their insulin. Absorption spectra showed that the cells absorbed some of the shorter waves, but that no bands were completely removed. Ultra-violet is absorbed so variously by organic substances that no physiological significance can be attributed to the specific absorption that these authors obtained.

Roskin and Schischliajewa ('34) obtained irregular results when they studied the effect of ultra-violet light on the oxygen uptake of *Paramecium,* although they concluded that in general the oxygen consumption was lessened.

B. VERTEBRATES

1. Entire organisms.—Various vertebrates were studied by Merker in connection with the problem of photosensitization.

He treated ('25a) the overwintered larvae of *Alytes*, a genus of obstetrical toads, the summer carp, and "Schlammpeitzger," an indefinite term for the Cobitidae, an Old-World family of small fishes, for several hours in .001 per cent neutral-red, and found that the illumination by a 1000-watt light gave notable increases in oxygen use. In a series of papers he reported this generally true. However, irradiation from the mercury arc always gave an important decrease in oxygen uptake. The paper by Merker and Braunig ('27) describes experiments with *Gammarus pulex* (young white fish), *Gasterosteus aculeatus* (a stickleback fish), *Rana esculenta*, and larvae of *Molge cristata* and *M. taeniata* (both belonging to the Old-World salamanders).

Harris ('25a) rayed rats in a small quartz respiration chamber with either a mercury arc operating on ½ kilowatt, or a carbon arc operating on ¼ kilowatt. He used the full arc, the visible only which he obtained by a plate glass filter, and ultra-violet only obtained by a "Blue Uviol" filter which passed rays between 2910 Å and 4360 Å. A constant temperature was maintained and the carbon-dioxide elimination was estimated at 15-minute intervals with an accuracy of ± .5 per cent. The results were calculated in terms of mgms. of carbon dioxide eliminated per square cm. of body surface. In one experiment neither the unscreened arc nor the visible alone gave a significant effect, but ultra-violet produced a definite stimulation. This author concluded that visible light nullified ultra-violet stimulation by a physiological antagonism, and not by any physical interference, and he made the interesting comment that this is the reason that human subjects suffer less in sunlight than when irradiated by equivalent dosages of pure ultra-violet.

It is not possible at the present time to conclude definitely concerning the physiological antagonism of different wave lengths of light. This phase of the problem must wait for the fuller development of monochromatic studies.

The work of Harris was questioned by Campbell ('26). He studied mice and rats in a constant-temperature chamber. The

unscreened illumination of a Cooper-Hewitt mercury arc, operating on 110 volts and 3.5 amperes, at a distance of 25 cm., was used for the first 1½ hours, a "Blue Uviol" filter for the next 1½ hours, and then an opaque screen for the next similar period. He found no metabolic effect, either immediate or delayed, of any of these spectrum regions.

The question was reopened by Crofts ('28a), who criticized previous students because they did not keep the rayed animals under observation for a sufficiently long period after the irradiation. She used canaries, because of their marked physiological sensitivity, and observed their oxygen use for a period of 6 days after irradiation. A Hanovia mercury arc was the source of illumination, at a distance of 25 cm., for a period of 10 minutes, this being equivalent to 14 lithopone units. The feathers were removed from the under side of the body to expose the skin. There was usually an abrupt drop in oxygen use immediately after raying, which averaged about 14.1 per cent. Single heavy doses caused a belated rise after the preliminary drop, averaging 21.6 per cent. Still heavier initial doses extended the period of depression. Daily rayings gave the usual depression, but no subsequent rise. It is particularly significant that there was no relationship between size of dosage and the amount of depression or elevation. This agrees with the present authors' results on yeast, which is reported in the third paper in this series, but it is improbable that similar mechanisms are involved.

Hardy ('28) extended the work of Crofts to rabbits, and increased the period of observation to 12 weeks. She used single doses of 24, 60, and 90 lithopone units, and also daily doses of 20 and 30 lithopone units which gave a total of 120 and 180 lithopone units respectively. She found no effect on the resting metabolism.

During the same year, Vasetko ('28) rayed white mice for 3 minutes with a mercury arc of the artificial sun type at a distance of 30 cm., and measured the heat production in a calorimeter for 10 hours. The heat production increased slightly. No observations were made on gas exchange.

2. *Individual tissues.*—The first observation on the effect of ultra-violet on the respiration of individual tissues was made by Gottschalk and Nonnenbruch ('23). They ground 2 gms. of frog muscle in 10 cc. of water to which .2 gms. of m-dinitrobenzol had been added. The preparation was rayed with a mercury arc at a distance of 70 cm. for periods of 15 to 90 minutes. Exposures of 45 minutes or less increased the oxygen use, the maximum stimulation of 24 per cent occurring with 30-minute exposures. Dosages of 60 minutes or more were depressing.

Wohlgemuth and Szörényi ('33c) placed the tissues of liver, kidney and skin in Ringer's solution, and studied the gas exchange by the manometric method of Warburg. A 75-watt lamp was suspended in the water bath 10 to 12 cm. from the vessel containing the tissue. In the absence of photosensitizers there was either no effect on the oxygen absorption or a slight depression, but in the presence of haematoporphyrin, there was a well-defined stimulation. This photosensitized fraction of the oxygen uptake apparently was not normal respiration, since it was not affected by temperature and since M/300 KCN not only did not inhibit it but actually had a stimulatory effect. Other experiments were carried out with a carbon arc drawing 30 amperes and with a quartz mercury arc. In these instances the light was removed 50 cm. from the vessels containing the tissues. In the presence or absence of sensitizers (haematoporphyrin or Bengal-rose) there was a decrease of the oxygen use. The sensitizers alone caused a decrease of 6 to 22 per cent, but when rayed with sensitizers the decrease was 17 to 43 per cent.

Guinea pigs that had been injured by raying usually showed an increased tissue respiration of the excised organs, and also occasionally an increase of anaerobic glycolysis. The authors postulated that these effects were probably due to the formation of toxic substances during the raying. They also ('33a) studied the effect of raying normal tissue of liver, kidney, skin, brain, and retina of guinea pigs. In the presence of sensitizers, irradiation with a carbon arc decreased oxygen use, probably because of a photo-oxidative destruction of protoplasm. If

sensitized guinea pigs were rayed until they showed acute photo-dynamic injury, the excised tissues showed an increased oxygen use, probably due to the formation of a toxic substance.

Since Ellinger had shown that ultra-violet irradiation changed histidin to histamin both *in vitro* and *in vivo,* Wohlgemuth and Szörényi (33b) attempted to show that histamin would call forth the same physiological effect as irradiation. Histamin stimulated the oxygen use by kidney, liver, brain, and skin, but Jensen sarcoma was unaffected.

3. Biochemical studies.—Pincussen ('21a) attempted to show an analogy between the action of ultra-violet on oxalic acid *in vitro* and *in vivo.* If oxalic acid is destroyed *in vivo,* then determinations of this substance in the urine can give no picture of oxidation within the body, and this uncertainty is further increased by the doubtful significance of its presence in the urine. In studying this problem, Pincussen injected oxalate subcutaneously into the rabbit, and then rayed the animal with a carbon arc. In control animals, 75 per cent of the added oxalate was recovered in the urine, but when the animals were sensitized by eosin or by the sodium salt of dichloranthracenedisulphonic acid, only about 45 per cent of the oxalic acid could be recovered. The conclusion was that oxalic acid was an end product of normal metabolism, and that irradiation caused the oxidation of the acid. By chemical analogy, the end product of the raying must be carbon dioxide and water.

Biochemical changes connected with metabolism were studied particularly by Pincussen and Zuckerstein ('29). Guinea pigs were fasted several hours, with and without previous eosin injections, then rayed, and killed 30 minutes later. A study of the individual organs showed that fat markedly increased in the serum but cholesterin did not change, while in the heart and liver, fat decreased but cholesterin increased. Eosin injection increased the magnitude of these effects. In the kidney, fat changed but little and cholesterin increased. The previous injection of eosin diminished cholesterin. In muscle, there was but little change in the absence of the eosin, but with it present fat was lowered.

In a further study of the biochemical changes in separate organs, Pincussen and Kawakami ('29) used a mercury arc operating on 140 volts and 4 amperes. Rats were rayed at a distance of 15 cm. for 30 minutes, after which they were killed and the organs removed. The liver and muscle showed an increase in glycogen and a decrease in lactic acid. The tables included in their paper show that the ratio, glycogen: lactic acid, is increased in the liver about 55 per cent and in the muscle about 45 per cent. In the heart no significant difference was found. The increase of carbohydrate in the organs of rayed animals had already been reported by Jacoby. The change in the glycogen: lactic acid ratio involves, according to these authors, a lower catabolism of carbohydrate, and probably also an increased synthesis, and the relation of these results to diabetes was suggested. Raying induces for a short period a small increase of blood sugar followed by a decrease. In diabetics, the sugar in the urine is also decreased, this being explained not by an increased oxidation of sugar but by its retention and storage in the liver and muscle as glycogen.

In later experiments, organs were removed from normal rats, minced, suspended in a thin layer, and then rayed with a mercury arc. The fact that results were not consistent indicates the possibility that the specific reaction of living animals to ultra-violet might not be due to the action of the irradiation as such, but rather to secondary reactions due to a generally disturbed metabolism.

Wohlgemuth and Szörényi (33a) reported that ultra-violet increased the anaerobic lactic acid formation in the absence of sensitizers, but diminished it in their presence. The source of radiation was either a carbon arc or mercury arc. Anaerobic glycolysis by the tissues of guinea pigs in the presence of sensitizers was shown ('33c) to be injured by intensive raying with a carbon arc. In the absence of sensitizers the glycolysis reaction was increased. Since ultra-violet irradiation had been shown to change histidin to histamin *in vivo*, they ('33b) studied the effect of histamin directly. Although tissue respiration was increased, anaerobic lactic acid formation was not changed.

C. HUMAN SUBJECTS

1. Irradiations from artificial sources.—Hasselbalch ('05) was the first to record the effect of ultra-violet on human metabolism. This worker rayed himself under carefully controlled conditions with a carbon arc, operating on 65 volts and 150 amperes. Relatively heavy exposures of about 1 hour were used, with the result that the frequency of inhalation was lowered, but the amplitude increased, the total ventilation therefore remaining unchanged. This condition may last for several days, and frequently longer than the erythema.

Durig, Schrötter, and Zuntz ('12) also found a slower rhythm of inhalation. The effect on actual metabolism was not definitely demonstrable, although their tables do show an increased use of oxygen by some subjects.

The results of raying patients suffering from various heart diseases were reported by Rubow and Sonne ('12). The carbon arc caused reduced frequency of inhalation and an increased amplitude, which were progressive in magnitude as the daily rayings continued. These results agree with those obtained by Hasselbalch on healthy patients. Rubow and Sonne observed that the development of erythema was necessary for the changes in inhalation and that super-sensitive patients who developed erythema with 5- to 10-minute exposures exhibited the typical reactions.

These data were verified by Austgen ('19), who rayed tubercular patients twice a week with the mercury arc at a distance of 70 cm., the dosage being increased from 3 to 20 minutes at each exposure. His results were very irregular. Of 70 patients, 35 showed no change, in 21 the rhythm of inhalation was increased, and in 14 it was lowered.

Éderer ('22) also studied this problem and reported that short exposures to the mercury arc had no effect on alveolar carbon-dioxide tension, but that moderate doses increased it, and large doses lowered it. These effects were found to be independent of the development of erythema.

Kestner, Peemöller, and Plaut ('23) observed an increase in oxygen use unless erythema developed. Their subjects had

fasted 12 hours, and were then rayed with a mercury arc at a distance of 50 cm. Animals with hair showed a reaction similar to the human subjects who developed pigment. These authors point out that the increase in oxygen absorption depends on the activity of the chemically active rays, and on the absence of heat rays. Since the application of heat to warm-blooded animals decreases their heat production this factor would counteract any stimulatory effect of the ultra-violet. This problem will be discussed more fully under the topic, "Theoretical considerations."

Several papers by Kestner and his co-workers ('23, '25, '26, '27) reported increased metabolism due to intense sunlight. Contrary to Kestner, Kroetz ('24) found that even though erythema always developed physiological changes occurred. The blood showed a temporary acidosis, followed by an alkalosis which was maintained for about a day. He attributed a stimulation of the respiratory center to the general effect of raying the organism. The presence of eosin did not influence these results.

Fries' ('25) experiments with children were carried out from December to March, since the ultra-violet from the sun is not strong enough during these months to confuse the results. Three children were kept on a controlled diet for one month, during which time their basal metabolism was determined three times a week. They were then rayed with a Hanovian mercury arc under various conditions, and the basal metabolism again determined three times a week. Each determination followed the raying by 20 to 70 hours. One patient was rayed 20 times in 24 days, one at irregular intervals, and one 7 times in 16 days. The exposures were at 24 inches at first, then lowered to 16, and began at 3 minutes and were gradually increased to 15. All three subjects became pigmented. Two other children not under controlled conditions were rayed. None of these 5 patients showed any increased metabolism. In two children rayed in the month of April to May, the metabolism rose after the third and fifth treatment and then fell 13 per cent and 11 per cent below normal. The ultra-violet

from the sun may have confused these results. The work of Fries shows that any prolonged rise in metabolism is not usual, and that although individual variation may influence the results, certainly the clinical improvement in malnourished children as a result of raying does not depend on an increase in metabolism.

Fries published later ('27) on the same problem and again found that the metabolism of rayed children did not vary more than 10 per cent. This is an insignificant variation in view of the inaccuracies of determining basal metabolism. In the same year, Fries and Topper ('27) extended the study. The patients were rayed 3 times each week at 20 inches with a mercury arc. The first exposure was 3 to 5 minutes, on the chest and back, and each succeeding exposure was increased 2 to 4 minutes. All patients developed good pigmentation. In the previous experiments, the metabolism determinations were made 20 to 70 hours after the irradiation, but in order not to lose immediate effects the determinations were now made before and after each treatment and also 2 and 6 hours later. There was no change in metabolism, pulse rate, or blood pressure, that exceeded experimental error.

A more extended study was made by Mason and Mason ('26) who rayed 10 patients with the unscreened mercury arc. Eight showed a notable lowering of heat production and a lower pulse rate. In no instance was an increased metabolism observed. The subjects showing a depressed metabolism were referable to two groups: (1) normal patients who pigmented well; (2) patients having an increased amount of circulating bilirubin.

The 5 individuals of the first group showed a lowered metabolism of 13.8, 15.6, 14.5, 7.8, and 10.5 per cent, which was proportional to the degree of pigmentation. Sometimes this lowered rate persisted as long as 23 days after the raying ceased. The 3 patients constituting the second group showed inhibitions of 24.1, 24.5, and 8.0 per cent. The interesting theoretical significance of these results are discussed under the heading, "Theoretical considerations."

Eichelberger ('26) rayed 9 women and 2 men in order to de-

termine whether creatinine was connected with respiratory metabolism. The fact that changes in creatinine excretion had no effect on metabolism convinced this author that they were unrelated.

2. *Irradiation as a climatic factor.*—Hasselbalch and Lindhard ('11) reported that with increasing altitude there is an increasing sensitivity of the respiratory center. This effect was attributed to the increased ultra-violet reaching the subjects from the rays of the sun. During the first day at a high altitude, there is an abnormally great sensitivity of the respiratory center, but physiological adaptation soon allowed a recovery. The final condition was a subnormal sensitivity. These authors believe that the lowered frequency and deepened amplitude of inhalation were due to the reduced tonus of the vessels in the skin.

A lengthy report, which unfortunately was based on scanty material, was published by Durig and Zuntz ('12). At a higher altitude the respiratory quotient remained constant, although the alveolar carbon dioxide and oxygen tension decreased proportionally to the altitude. The body temperature was not affected. An increased frequency of breathing was shown by 2 subjects, while 1 showed an increase. The amplitude of inhalation also was decreased in 2 subjects, but increased in 1. These results are obviously unconclusive. In the same year, Durig, Schrötter, and Zuntz (12) attempted to correlate high altitude effects with those produced by artificial raying. The result of raying depended on the individual and on the intensity of exposure. The alveolar carbon dioxide was reduced, and many subjects showed a decreased frequency but a greater amplitude of inhalation. It was concluded that climatic effects had no correlation with those of raying.

Kestner and his co-workers have maintained in a series of papers that the short-wave irradiation in high-altitude sunlight stimulated human respiratory metabolism. Kestner, Peemöller and Schadow ('27) reported the results of 5 men ascending a mountain, each person making metabolism tests on himself. The locality was chosen so as to obtain the most in-

tense solar rays possible, but at an altitude of less than 3000 m. so that the oxygen pressure would not be a disturbing factor. The intensity of the radiation was measured by a cadmium cell and an electrometer. This cell almost exclusively reacts to wave lengths less than 3200 Å. Dorno had shown that this length is the most physiologically active on man. This climatic study showed that this spectrum region stimulated respiration and gas exchange. Through over-heating the metabolism was greatly reduced. Wave lengths less than 3200 Å were called by these authors the "Ra" rays. This is an unfortunate term, since it might reasonably be confused with radium emanations if the student were not familiar with the details of the experimental procedure.

During the same year, Kestner and Schadow ('27) reported a similar study carried out at the Jungfrau Pass. The rays shorter than 3200 Å again stimulated the oxygen use. These authors state that the diminished oxygen pressure at this altitude caused a deepened amplitude of inhalation. The "Ra" rays appeared to penetrate relatively thick masses of clouds, and the reflection from the snow was also found very important.

Crofts ('28b) rayed 2 subjects with a "Uviarc" which gave 6.6 lithopone units of ultra-violet in 8 minutes at 18 inches. The dosages were as follows: 5 L. U., 6½ L. U., a total of 20 L. U. distributed over a series of rayings, incrementally repeated rayings giving a total of 17½ L. U., 3 large doses giving a total of 19.8 L. U., incrementally repeated rayings giving a total of 44.9 L. U. distributed over a period of 6 days. Even though these dosages were in excess of usual clinical treatments, there was no appreciable effect on metabolism.

A very excellent review by Lippman ('28) contains the generalization that ultra-violet in low erythema doses increases the oxygen use during the period of exposure 5 to 10 per cent. After 30 minutes, the oxygen consumption falls, often below normal.

A report based on copious clinical material by Lippmann and Völker ('28) is one of the most important contributions in this field. Dosages varied between 1.5 and 6.5 erythema units.

During the actual raying there was an increase in metabolism of 10 to 18 per cent, this stimulation not depending on the size of dose nor upon the intensity of the developing erythema. The fact that mere uncovering of the patients produces some increased metabolism lessens the significance of the results. The respiratory quotient showed a slight lowering, perhaps due to oxidation of the non-carbohydrate substances which Pincussen considers to be proteins. These authors believe that the variations which they obtained in the respiratory quotient were too small and variable to be significant. The volume and frequency of breathing also remained unchanged. There was no time effect during the 24 hours of observation after the raying. There was no significant change in nitrogen metabolism, and the slight decrease in the blood sugar was within the limit of usual variations, being from .32 to .27, .30 to .25, and .24 to .20.

Lehmann and Szakáll ('32a) reported that raying laborers with a mercury arc at weekly intervals lowered their basal metabolism 10 to 15 per cent and increased the capacity for work up to 60 per cent. There was a decrease in the oxygen debt. These effects were thought to be similar to those of muscular training. Another experiment ('32b) reported that when the same subjects were rayed, but with a screen interposed which eliminated the ultra-violet without their knowledge, the increase in work capacity did not take place. Rubow and Sonne ('12) had reported previously that patients suffering with heart diseases reacted favorably to irradiation and that their capacity for muscular work increased.

In a more complete study, Lehmann ('33) rayed a patient for 5 minutes and then measured the heat production hourly for 22 hours. There was a small increase until 7 hours after raying, at which time erythema developed. From this point onward there was a progressive decrease, although sometimes the value was still above normal for several days. In another experiment, weekly averages were obtained for 17 weeks. During the fourth week, the ultra-violet dosages were 3 minutes, and in succeeding weeks they were increased to 6, 10, 15, 20, 30,

and 40 minutes. There was no raying during the remaining 5 weeks. The results are very definite, and the curves representing them are among the best that have appeared. The elimination of carbon dioxide showed no important change, while the oxygen use decreased continuously until the rayings were stopped and then showed a progressive return to the normal during the succeeding 5 weeks. The curve representing heat production parallels very closely the above oxygen changes. The oxygen debt also was parallel to that of heat production.

D. THEORETICAL CONSIDERATIONS

It is difficult to come to positive conclusions concerning the relation of animal metabolism to ultra-violet light. At first glance the experiments of Merker and his co-workers on lower forms show that a 1000-watt filament lamp increases the oxygen uptake, but that a mercury arc always decreases it. However, the presence of eosin confuses any determination of what wave lengths are effective, and, as he himself admits, the increased movement of the rayed organisms may have caused the increased oxygen uptake. Also, the method by which he determined oxygen use is open to criticism, and the curves which he published are extremely unsteady. However, if we give full credence to Merker's results, raying eosin-treated organisms with a 1000-watt light caused an increase of oxygen uptake which resembled that produced by increased temperature. These experiments contribute but little to an ultimate theory of ultra-violet physiology.

The fact that Sonne used pupae, which showed no movement when rayed, and that he used a mercury arc, a much more potent source of ultra-violet, makes his experiments of more significance. He obtained an important increase in oxygen use. Although his organisms were injured, making it impossible to draw conclusions concerning the effects of ultra-violet itself, yet this author's work is the best evidence available that lower forms are stimulated in their oxygen uptake by ultra-violet light.

The work on vertebrates may be summarized with greater assurance. In the absence of factors depending on pigmentation, it is probable that such sensitive organisms as canaries, and, to a lesser extent, white mice, etc., may show increased metabolism. But even here the results are irregular. It is to be noted emphatically that the dosages given in such experiments are greatly in excess of any that might be given therapeutically to human beings, and any suggestion that ultra-violet light owes part of its clinical effect to increased respirational metabolism is without foundation.

The above statement is made with full knowledge of the very positive opinion of Warnshius ('33). This author states that ultra-violet irradiation of human patients "is the most valuable and perhaps the most positive means for the improvement of oxidative processes." This paper contains a large amount of loosely organized theory purporting to show that ultra-violet light has a greater anti-rachitic power than vitamin D, which he attributed to the improved oxidative power of the blood enzymes. He further states that vitamin D is probably only another oxidative enzyme or a precursor or an intermediary of other oxidases. Ultra-violet acts, then, by activating the oxidizing enzymes and this affects the mineral metabolism. This theory cannot be substantiated by data in the literature.

Ultra-violet experiments with human beings have not always been above criticism. Scanty clinical material, poorly controlled conditions, and faulty technique have thrown an undeserved appearance of futility in this field of research. After evaluating the various published results on the basis of the conditions under which they were obtained it is fairly certain that ultra-violet irradiation gives no stimulation of respiratory metabolism. If the effects of irradiation are influenced by pigments, such as melanin, bilirubin, etc., there is a decrease in oxygen use because the pigments degrade the incident irradiation into the longer wave lengths. The total effect is, then, the same as the addition of heat to the body, and consequently there is need of less intracellular oxidation. This viewpoint might be conclusively checked by raying negro and

white patients. The difference in pigmentation is here so great that there should be a marked drop in oxygen use by the colored patients long before the pigments could develop in the white patients, and the usual unavoidable variations should become insignificant.

Merker ('25c), in a long review of the biological effects of fluorescent dyes, suggests that they may act either as oxygen carriers, or under other conditions they may destroy cellular oxidizing mechanism. These suggestions are worthy of consideration, but it is possible that fluorescent substances inhibit by some physiological effect, depending on their emission spectra.

The mechanism by which photo-sensitizers affect oxidation is still controversial. Gaffron ('33) believes that the oxidizing effect of irradiated dye solutions depends on an activation of the oxidizable substance. An extended study of this problem was carried out by Kautsky, Bruijn, Neuwirth, and Baumeister ('33). They believe that the photodynamic effect of a fluorescing dye is due to a meta-stable condition of oxygen. The oxygen absorbs energy from the fluorescing dye molecule and thereby causes fluorescence to disappear. Since the meta-stable oxygen has a finite time existence it may diffuse away from the point of activation to an oxidizable body which is itself not irradiated. This mechanism was convincingly demonstrated by irradiating tryptoflavine and observing the resultant oxidation of leuco triphenylmethane and also leuco malachite green. These reduced dyes were maintained in silica jell some distance from the point of irradiation.

The statement of Wickwire and Burge ('27) that ultra-violet inhibits the oxygen use of Paramecia by destroying the activity of insulin is suggestive, but it seems a far cry to assume that these organisms are so similar to higher forms as to possess an identical mechanism of sugar utilization.

The reports covering the stimulation of metabolism by solar rays and under various climatic conditions are subject to too much criticism of technique and are based on insufficient material to be of theoretical importance. This is also the attitude of Flickinger ('26).

III. Metabolism of Plants

A. Fungi

1. Bacteria.—Schnitzler and Henri ('09) were the first to observe the effect of radiations from a mercury arc on bacterial metabolism. They studied acetic acid fermentation of various wines, red Algerian, white Algerian, and a mixture consisting of 100 parts of wine, 200 parts of water, and 4 parts of glacial acetic acid. The solutions were irradiated at a distance of 15 cm. in 50-cc. samples, 1 cm. deep, and in 200-cc. samples, 4 cm. deep. An exposure of 30 minutes completely stopped acetic acid fermentation, while shorter exposures were inhibitory to a less degree. Special tests indicated that the ozone formed by the ultra-violet light was without effect, and that wave lengths shorter than 3021Å constituted the effective spectrum region. It is particularly significant, as will be pointed out later, that if the wine were rayed in the absence of oxygen the ultra-violet was without effect.

This paper was followed by a more complete report the following year ('10). The irradiation was carried out as before, and the cultures watched for 3 to 9 days in a water bath maintained at 25° C. The experimental solution consisted of 100 parts of red wine, 200 parts of water, and 4 parts of glacial acetic acid. Irradiation for 30 minutes decreased the amount of acetic acid from the control value of 5.90 to 5.05 per cent. Shorter dosages were proportionally less inhibitory. The fact that even 40-minute rayings were without effect in the absence of oxygen emphasizes their previously published results. Traces of hydrogen peroxide gave not only similar inhibitory results but also produced the same color changes in the wine as did irradiation. Hence it was concluded that the toxic effect of ultra-violet irradition by wave lengths shorter than 3021 Å depends on the formation of hydrogen peroxide in the presence of atmospheric oxygen.

The actual possibility of hydrogen peroxide developing in irradiated water solutions will be more fully discussed in the section on peroxidase.

The first data concerning the effects of ultra-violet light on

the respiration of bacteria in pure culture were reported by Cook and Stephenson ('28). They studied primarily the relation of viability of the bacterial cell to its aerobic oxidation of glucose and certain of its fermentation products, and irradiation with ultra-violet was only incidentally introduced as a means of reducing viability. They grew *Bacillus coli* on tryptic broth agar to which .5 per cent sodium lactate had been added. After 24 hours, the cells were suspended in phosphate buffer at pH = 7.4, centrifuged, then washed twice in Ringer's solution, and finally suspended in 100 cc. of Ringer's solution, and aerated for 15 minutes in order to obtain an even suspension. This stock suspension was diluted with an equal volume of Ringer's solution, and 1 cc. was used for each determination. Glucose, 1/200 M, was used as the control culture. The substrates, lactate and pyruvate, were studied in 1/100 M concentration, and acetate, ethyl alcohol, acetaldehyde, formate, oxalate, and glycollate were also studied. In order to decrease the viability of the cells, they were rayed in quartz test-tubes at a distance of 6 inches from a mercury arc for 20 and 30 minutes. Super heating was avoided by protecting the culture tube by another and larger test-tube. The suspensions rayed for 20 minutes showed 2.74 viable cells in each 1000; those rayed 30 minutes showed 2 viable cells in each 1000.

The effects of ultra-violet on the respiration process, aside from the mere killing of most of the cells, can only be inferred. At first, there was a slight decrease of oxygen use, but later there was no significant difference. This preliminary period of slight inhibition was attributed to an injury to the respiratory enzymes, although no actual tests were made. Since a reduction of the number of cells by dilution gave a rate of oxygen use proportional to the number of cells, and since a reduction of living cells by irradiation did not materially affect the respiration, these authors concluded that living and dead cells oxidize alike.

The oxygen uptake was measured by differential manometers of the Haldane-Barcroft type. It was assumed that if the control culture were placed in the vessel on one arm and the

experimental culture in the vessel on the other arm, the movement of the manometer liquid would indicate the difference in rates. If all the forces acting on each limb of the manometer were perfectly symmetrical, then the above assumption would be valid. This can rarely be the case in actual experimental procedure, as can easily be determined by placing duplicate aliquots in each vessel. Experiments by Wynd have shown the unsuitability of this method, and errors from this cause alone might easily be of such magnitude as to account for any of the differences between the normal and rayed cells in the experiments reported above.

Lohmann's ('34) study of *Bacillus coli*, tubercle bacilli, and *Streptococcus* is the only one that has been directed specifically to determining the effect of ultra-violet on the respiration of bacteria. *Bacillus coli* was grown in a buffered Ringer solution which contained sugar. This medium allowed no reproduction, and the cultures exhibited a constant rate of oxygen uptake as determined by the Warburg method. A bouillon medium which allowed reproduction was also used. Tubercle bacilli were cultured on Lockemann's medium. The most complete data reported in this paper concerned *Streptococcus*. The culture was diluted with 9 volumes of colorless Ringer solution at pH = 7.4. An exposure in a quartz flask to a mercury arc for 45 minutes lessened the oxygen uptake about 50 per cent, and this rate was maintained for several hours. After 7 or 8 hours new growth caused an increase in oxygen use and in elimination of carbon dioxide. An exposure of 80 minutes stopped growth completely and almost all of the respiration, but new growth began after 12 hours. Rayings as long as 3.5 hours did not completely sterilize the cultures.

Experiments on *B. coli* showed that exposures of 3 minutes resulted in a constant use of oxygen, showing that growth had been stopped although metabolism remained uninjured.

2. Botrytis.—Fazi ('23) reported that fermentation of grapes infected by *Botrytis cinerea* was stimulated by exposure to the mercury arc. Although it cannot be said that this result is not valid, yet, as will be shown later, all of the work reporting

increased fermentation in yeast by ultra-violet is open to serious criticism.

3. *Yeast.*—The effect of irradiating yeast on respirational activities was first observed by Maurain and Warcollier ('09). They used a mercury arc of the Poulenc type, operating on 110 volts and 2.5 amperes. Sweet cider was rayed in layers 1 mm. deep, at a distance of 5 cm. An exposure of 3 minutes killed fermentation. If the cider were diluted with 20 parts of water, then 2 minutes stopped fermentation. If the layer were reduced to ¼ mm., 2 to 3 minutes were completely inhibitory.

In the following year, these authors ('10) extended their observations to foaming white wine in an effort to determine if irradiation might be used to inhibit the undesirable late stages of fermentation. The wine was in layers 5 mm. deep, and was 4 cm. removed from the mercury arc. Irradiation for 10 seconds completely inhibited fermentation. The greater sensitivity of the white wine was due to its greater transparency for the effective radiations.

The most prolific writer in this field of research is Fazi. His name first appears in the literature in the announcement of a British patent ('14) for carrying out commercial fermentation under the influence of ultra-violet light. He points out that either sunlight or "Uviol" lamps may be used as the source of irradiation. The fermentation vats were to be made of "Uviol" glass, or the lamps immersed directly in the liquids. The announcement of this patent was followed by a long series of papers, all purporting to show great stimulation of fermentation by ultra-violet light. The first paper reported that beer yeast could be rayed profitably even for as long a period as 12 hours, and that it was not injured by 14 hours of exposure. The irradiation was carried out in quartz flasks, 20 cm. from the mercury arc.

Fazi and Fazi ('16) describe experiments showing that *Saccharomyces opunitiae* lives, reproduces, and ferments more actively when stimulated by irradiation. Many hours of exposure were needed to cause injury. Also, the must of India figs forms abundant film on the surface in ordinary fermenta-

tion, but under the influence of ultra-violet there was no trace of film. These authors later ('17) mixed *Saccharomyces cerevisiae* with *S. opunitiae* and found that the rate of fermentation of fig must was doubled by ultra-violet light. The change of sugar to alcohol and carbon dioxide was almost complete, while in the unrayed cultures there remained a residue of sugar. Pure cultures of *S. cerevisiae* also were rayed in fig must, and at the end of the experiment the samples contained less acid, about 10 per cent more alcohol, and a smaller residue of sugar.

Fazi ('21) published new data in order to contradict a paper by Feuer and Tanner ('20), who had stated that their yeast could not endure more than a 1-minute exposure. Fazi not only states that this result is opposed to his own, but also to the observation of many others. He mentions particularly Henri and Stodel ('09), Cernovodeanu and Henri ('10), Vallet ('10), Lombard ('10), Van Aubel ('09). Fazi claims to have done much work on bacteria and on yeast, although there is no extensive publication of data. In the above paper he described experiments in which brewer's yeast was rayed for 12 hours with a 1200-candle power lamp at 20 cm. The yeast was not injured and showed an increased fermentation, but all the bacteria in the suspension were destroyed. This method of clearing yeast from bacteria was instituted in 1918 by the Peroni Brewery, in Rome.

The significance of Fazi's paper was completely nullified by the reply of Feuer and Tanner ('21) in which they state that Fazi misquoted them in saying that the yeast died with 1 minute of raying, since they actually had said that some samples endured exposure for 7 minutes. It is significantly pointed out that the suspensions were very dilute, consisting of a single loopful of inoculum in 9 cc. of water, and then rayed in thin layers at a distance of 25 cm. It is a surprising fact that none of the 5 papers cited above by Fazi in support of his results mentions yeast in any connection whatever!

Fazi and Fazi ('22), in support of their previous contentions, say that tests on an industrial scale confirm their results in the

laboratory, that yeast previously treated by ultra-violet exhibited stimulation of fermentation activities. The possibility of commercial applications was pointed out for the third time two years later ('24). This paper claimed that ultra-violet reduced the time for proper fermentation of beer 25 per cent, reduced time of maturation 40 per cent, and that it improved the flavor and storage qualities. The temperature of the fermenting liquid might be held as low as 4° to 6° R., and the fermentation was still greater than at the usual warmer temperatures.

The last paper by Fazi ('27) describes the effect of raying glucose solutions before inoculation by *Saccharomyces cerevisiae.* Although the yeast itself was not rayed, it showed an increased fermentation and produced a smaller amount of acid. He concludes that the preliminary exposure of the glucose solution imparts bactericidal properties, which, however, do not inhibit the yeast. Fewer bacteria were found in solutions which had been rayed.

Lindner ('22) was one of the earliest supporters of Fazi. He used bottom brewer's yeast and found that the velocity of fermentation was increased by ultra-violet to an even greater degree than originally claimed by Fazi for top yeast. For instance, 30 gms. of glucose in 300 cc. of water yielded in 24 hours 119 cc. of carbon dioxide, while a similar solution rayed with a mercury arc gave 2743 cc.! The original and the rayed yeast contained but little glycogen, but significant amounts were present in yeast cells that were allowed to ferment in the absence of ultra-violet. This is consistent with the results on fermentation. A most interesting observation in this paper is that 20 to 30 per cent of the cells in the rayed solutions had died. The present writers' experiments on yeast, which are reported in the third number of this series, show that fermentation is inhibited by ultra-violet even *before* a significant number of the cells show mortality. Minor variations in the substrate were shown by Lindner to be ineffectual in disturbing the results, since the use of wort gave similar effects to that of glucose.

A more scientific approach is that of Gronchi who showed

('32a, b) that the shorter wave lengths were toxic to fermentation of yeast. He reported irradiating *Saccharomyces cerevisiae* for 45 minutes at 40 cm. Wood's light caused an increased production of carbon dioxide which continued some time after the irradiation stopped. The shorter ultra-violet excited fermentation, but this increase was of short duration and stopped when the irradiation did, and from this point onward the elimination of carbon dioxide was diminished.

The next attempt to show a favorable effect by ultra-violet light on yeast fermentation is that of Owen ('33) and his coworkers. He used a National Carbon Company carbon arc, which is rich in the wave lengths 2300 to 3100 Å. Seven grams of yeast cake were added to 100 cc. of 5 per cent glucose and exposed in a shallow pan. Exposures of only 10 or 30 seconds imparted an increased fermentative power. The greatest difference between the control and experimental cultures occurred about 1 hour after irradiation. Owen reported a commercial application of irradiated yeast to bread baking, since 24 per cent less yeast is needed if it be previously rayed 10 seconds. However, it is highly probable that the quantity of yeast ordinarily used by bakers is in excess of that needed, and the fact that 24 per cent less gives proper leavening does not prove any beneficial effect of irradiation.

The most extensive report on stimulatory effects is that of Owen and Mobley ('33). These workers rayed seed yeast in the same type of solution as was to be fermented, the wort itself and colonies on molasses agar. The wort was prepared from Cuban Black Strap molasses to which was added 1 cc. of sulphuric acid and 1 gm. of ammonium-sulphate per liter. Pure cultures of Magne yeast were used. The raying was accomplished by dripping the wort through a funnel at 15 cm. from a carbon arc.

In one experiment type "C" carbons of the National Carbon Company were used, which gave radiations from 2700 to 3000 Å. The inoculated wort was run through the funnel three times before the arc. After 72 hours the efficiency of the alcoholic fermentation was as follows:

Control	80.62 per cent
Control	83.20 per cent
Rayed	83.10 per cent

These results are not impressive evidence for stimulation.

Another experiment was carried out with type "B" carbons, and the fluid passed 5 times through the funnel. After 72 hours the results were:

Control	88.9 per cent
Rayed	90.8 per cent

A third experiment differed from the above in that the suspension was passed 6 times through the funnel. After 48 hours the efficiency of the alcoholic fermentation was:

Control	83.3 per cent
Rayed	85.2 per cent

It was further reported that raying the yeast on agar plates and then transferring it to the wort were almost as stimulative as raying the inoculated wort. Irradiation of the media was also held to be beneficial. "B" carbons were used, and the distance is not given. The results were:

Control	80.3 per cent
Control	82.8 per cent
Colonies rayed	83.4 per cent
Colonies rayed	80.3 per cent
Seed rayed in wort	87.5 per cent
Seed rayed in wort	84.0 per cent

The scant data and the obvious variation in the duplicates are not convincing evidence for stimulation. These authors concluded with the statement that irradiation by the carbon arc was beneficial because of the development of some "growth-promoting" substance which stimulated the fermentation of sugar. It is obvious that a "growth-promoting" substance is something that promotes *growth* and not necessarily the fermentation of sugar. This improper terminology is more plainly demonstrated by the values given for the actual num-

ber of cells per cc. as related to the period of irradiation. These values after 32 hours were:

Control	168,000,000
Rayed 1 minute	116,000,000
Rayed 2 minutes	182,000,000
Rayed 3 minutes	48,000,000
Rayed 4 minutes	82,000,000
Rayed 5 minutes	12,000,000
Rayed 6 minutes	16,000,000

In spite of the erratic values, which vary from about 30 to over 100 per cent from a smooth curve, there is evidently no "growth-promoting" substance acting as a result of irradiation.

Surányi and Vermes ('29), employing the Warburg technique, were the first to observe the effect of irradiation on the use of oxygen by yeast. The nutrient medium was the Tyrade solution at pH = 7.2. Exposures to ultra-violet light gave an increase in oxygen use of about 50 per cent. Cyanide inhibited the increased fraction of the total as well as normal respiration, and this effect was reversible. Avian erythrocytes gave similar results.

The evidence of the inhibitory influence of ultra-violet on fermentation is more convincing. Söhngen and Coolhaas ('23) were the first to differentiate between decrease of reproduction and of fermentative power. They observed that neither fermentation nor reproduction was affected unless the distance from the lamp was great, the volume of solution large, and the time of exposure short.

Tanner and Ryder ('23) extended their earlier work in view of the objections raised by Fazi. They rayed 20 different species of yeast with a Cooper-Hewitt lamp operating on 110 volts and 4 amperes, at 20 cm. from the cultures. One loopful of each was inoculated in 100 cc. of sterile water, and 1 cc. of this suspension was added to 99 cc. of sterile water. The final suspension was rayed in layers 8 mm. deep in Petri dishes, after which 1 cc. was plated on acid Sabouraud's agar. Ex-

posures of 1.5 to 20 minutes were required to kill the various species. The loss in weight from 30-day cultures of *Saccharomyces ellipsoideus* showed that 1- to 10-minute exposures had no effect on fermentation, but that longer exposures inhibited proportionally. Since bacilli were killed under similar conditions in 1.5 to 6 minutes, it was concluded that the size of the cell determines its resistance to ultra-violet.

Abderhalden ('27) raised the next dissenting voice. He rayed fresh yeast, dry yeast, macerated yeast, and press juice with a mercury arc and with a magnesium light. He added both rayed and unrayed egosterin and cholesterin, and under no condition did he find stimulation of fermentation. He concluded that fats are not concerned in yeast fermentation, and from his data it may be inferred also that ultra-violet itself was not stimulatory.

Tanner and Byerley ('34) reported the inhibitory effect of ultra-violet on *Saccharomyces cerevisiae* and on Fleischmann's commercial pressed yeast cake. They rayed glucose-broth cultures, aqueous suspensions before seeding, fermenting cultures and glucose-broth before its inoculation, with a Cooper-Hewitt mercury arc at a distance of 25 cm.

Oster ('34), in the most careful study yet made on the subject, reported the effect on respiration in terms of oxygen use. He used monochromatic light from the mercury arc, including all those lines which are of sufficient intensity to be practically applied. The results were reported in terms of the wave length used, the total energy in terms of ergs per sq. mm. per second. The oxygen use was observed by the Warburg technique. The respiration curves were run for 2½ hours. At the end of the experiment, the suspension was removed and plated on agar to discover any morphological changes induced by the raying. The conclusions were that there was no stimulation of growth and no change in the oxygen use until the cells were injured as shown by morphological studies when there was only a decrease. About 22 per cent decrease in oxygen uptake occurred when the total energy exceeded 81.6×10^4 ergs per sq. mm. per second, this value being obtained by exposure to the line 2536 Å

for 60 minutes. The region 2482 Å to 3132 Å showed about the same degree of inhibition, although the total energy was 408×10^4 ergs per sq. mm. per second. The effect is not one of total energy alone but also one of individual wave lengths, since it is proportional to total energy for any one wave length, but different total energies were needed for the different wave lengths to produce a given effect. This paper is one of fundamental importance and contains too much material to be reviewed completely here.

B. GREEN PLANTS

The only study on the effects of ultra-violet light on the respiration of higher plants is that of Masure ('32). He used a Cooper-Hewitt mercury arc operating on 110 volts and 4 amperes, and a Corning G586AW "Ultraglass" filter, 9 mm. thick, and passing wave lengths from 3334 Å to 3690 Å. Because of the characteristics of the mercury arc, this filter showed a peak of transmission in the region 3650 Å to 3663 Å. The mercury arc triplet at 3663 Å, 3665 Å and 3650 Å constituted about ¼ of the total radiant energy passed. Since the line at 3650Å was about ½ of the total intensity of the triplet, the light was practically monochromatic at 3650 Å. This line has been shown to be within the transmission region of certain seed coats.

Three varieties of pea seeds were rayed in Petri dishes for periods of 15, 30, 60, 120, and 265 minutes, and planted immediately after. The hypocotyls were measured after 4 days to determine the effect of raying on growth. Respiration was observed in etiolated seedlings rayed at 27 cm. through the G586AW filter. The flask was in a water bath, which caused the elimination of the longer infra-red. Since window glass transmits down to 3200 Å, the thin glass of the flask probably passed most of the band at 3650 Å. The seedlings were rayed 62 minutes, then after 50 minutes they were rayed a second period of 49 minutes. The technique of measuring the oxygen uptake was not so refined as might be wished, but it appears from these experiments that the absorption of oxygen was temporarily increased by irradiation.

C. THEORETICAL CONSIDERATIONS

The work of Cook and Stephenson might be interpreted as indicating that *Bacillus coli* was unaffected, but, as pointed out above, the balancing of one limb of the differential manometer against the other introduces errors that might conceal small differences. It should be noted, however, that this error need not be present if the two vessels were identical *in every way.* This could be determined experimentally by putting duplicate aliquots in both vessels; and should the manometer liquid remain at a constant level, then the method of Cook and Stephenson would be sound. But these authors specifically state that they "assumed" this condition. The present writers have never been able to obtain symmetric behavior of pairs of manometer vessels. The work of Lohmann shows only inhibitory effects.

The work on acetic fermentation is even more difficult to interpret, since no data were given that would make possible the necessary distinction between inhibiting the fermentation itself and the actual killing of the fermenting organisms. It is significant that acetic acid fermentation was not inhibited if the irradiation occurred in the absence of oxygen. This indicates that the inhibiting action does not depend on the specific effect of the ultra-violet in destroying the oxidizing mechanisms, but rather on some toxic oxidation that ultra-violet induced by the presence of oxygen.

The earlier work on yeast fermentation is open to the same objection, since no distinction was made between fermentative activity and the killing of the cells. The evidence for the stimulation of yeast fermentation centers around the work of Fazi and of Owen and their co-workers. When we note that Fazi's name appears twice in the announcements of commercial patents, and three times in articles emphasizing the desirability of commercial application, the actual amount of new scientific evidence advanced to support his belief is small. The work of Owen and co-workers is to be criticized even more severely. Their actual experimental results, which have been partly quoted above, are sufficient indication that no significant differences were found.

The favorable effects of irradiating the nutritional medium reported by both Fazi and by Owen are worthy of further study. Woodrow, Bailey, and Fulmer ('27) found that the irradiation of sucrose, glucose, calcium gluconate, and glycerol imparted toxic properties to yeast. Euler and Lindberg ('12) found that rayed glucose solutions develop a gas mixture containing about 15 per cent carbon dioxide, 40 per cent carbon monoxide, and 40 per cent hydrogen. They also showed that ultra-violet light anaerobically split lactic acid in water solutions into alcohol and carbon dioxide. These reactions are all purely photochemical, and such effects must be considered in interpreting results.

The work of Bierry ('26) is particularly interesting because he also found that ultra-violet could act on carbohydrates similarly to certain enzymes, making possible an "ultra-violet fermentation." He found that d-fructose, and to a less extent d-glucose, in the presence of air is degraded by ultra-violet to formic aldehyde and carbon dioxide. Sucrose is hydrolyzed by the irradiation and then degraded to carbon dioxide and formic aldehyde.

The evidence against the stimulation of yeast fermentation is based on more stable foundations. The present writers report their results in the third paper of the series.

There is not yet sufficient evidence in the literature concerning the effect of radiation on the higher plants to form definite conclusions. The present writers report in the second number of this series their work on tomato and bean plants.

IV. Oxidizing Enzymes

A. Catalase

1. In vivo studies. a. Animals.—Ostwald ('08) rayed larvae of *Porthesia chrysorrhoea* with sunlight and found that both violet and white light reduced the amount of catalase activity below that found in larvae treated with yellow light or with darkness. The amount of ultra-violet light reaching the organisms in these experiments is very uncertain.

The first *in vivo* study of the effects of relatively intense

ultra-violet light on animal catalase appeared in 1926. Pincussen, in a series of papers on the changes in the enzymatic content of the blood, points to the probability that ultra-violet affects the organism by increasing oxidation. This assumption was based on previously published data showing that ultra-violet exhibited an oxidative effect when studied *in vitro*. Recent developments, particularly in the chemistry of the enzymes, show that *in vitro* studies are not necessarily applicable to the interpretation of *in vivo* phenomena.

Pincussen approached the problem by observing the catalase activity of the blood of rabbits after they had been exposed to bright sunshine from 10 o'clock a. m. to 4 o'clock p. m., and also after being irradiated by a mercury arc. Animals in the sunlight always showed a lower reaction constant of the catalase than those kept in darkness. The magnitude of this decrease was not changed materially when 2 cc. of 2 per cent erythrosin were injected subcutaneously. Neither were 10 cc. of 2 per cent potassium iodide administered orally effective in altering the effect of sunlight. Rabbits irradiated for 12 minutes by a mercury arc at a distance of 100 cm. showed a lowering of the reaction constant from .0621 to 0.410. That this decrease was not a transitory effect was shown by raying rabbits 12 minutes at a distance of 90 cm., and withdrawing blood samples periodically until 120 minutes had elapsed. The reaction constant showed a progressive decline as long as the observations were continued.

The blood catalase of animals rayed by the mercury arc was markedly more decreased in the presence of potassium iodide and eosin than in those treated with sunlight. This was explained by assuming that the eosin was not acting as a photosensitizer for catalase, but by increasing the amount of free iodine splitting from potassium iodide. In these experiments there was also a progressive decrease during the 2 hours of observation after raying.

Somewhat different results were obtained by Castagna ('27a). After keeping white mice in the dark, he rayed them with the mercury arc, using both the visible rays plus the ultra-

violet and also the ultra-violet alone from 3900 Å to 3190 Å. The catalase of the blood was determined at intervals of one-half hour, and it was found to increase during the first 3 hours of raying when the open arc was used and then to drop to normal after several hours. When the wave lengths 3900 to 3190 Å were used alone, there was no significant change. This author's conclusion, that visible light increased the enzyme or protected it from destruction by some natural process, and that irradiations shorter than 3190 Å were destructive, does not adequately explain these results. It should be noted that these dosages are very much greater than those used by Pincussen.

It will be remembered that Harris ('25a), in his study of the effect of light on the carbon-dioxide elimination of rats, found that the open mercury arc had no effect, while the ultra-violet of 2910 Å to 4360 Å gave a stimulation. He concluded therefore that visible rays nullified the ultra-violet stimulation by physiological antagonism.

Koldaev and Al'Tshulla ('30a) published data that is compatible with those of Pincussen. They rayed 20 rabbits with a mercury arc and observed the changes in catalase, lipase, and amylase in the blood. Single rayings gave a temporary decrease in catalase, while successive doses produced a progressive decrease. The above data appeared in Russian and was apparently republished the same year in German ('30b).

Pincussen and Tanino ('31) rayed white rats, which had been starved for 16 hours, with a mercury arc operating on 220 volts at a distance of 50 cm. The animals were then killed and 10 cc. of the diluted tissue extract were added to 10 cc. of 1 per cent hydrogen peroxide. The mixture was buffered at pH = 6.8 by phosphate. The results were as follows:

CUBIC CENTIMETERS OF OXYGEN EVOLVED IN 5 MINUTES

	1 cc. blood	1 gm. liver	1 gm. spleen	1 gm. heart
Control	1427	7129	606	178
Rayed 30 minutes	1534	5659	722	182
Rayed 60 minutes	1454	5173	665	172
Rayed 90 minutes	1648	7104	700	157

The significance of these data will be discussed under the topic "Theoretical considerations."

1. In vivo studies. b. Plants.—*In vivo* studies on plants concerning the effect of irradiation on the catalase are less numerous than those on animals. The effect of sunlight on yeast catalase was observed by Euler and Laurin ('18). They mixed 15 cc. of a suspension of *Saccharomyces thermantitonum* containing .0885 gms. of fresh yeast with 100 cc. of phosphate buffer at pH = 6.1 and with 50 cc. of .01 N hydrogen peroxide. Exposure of the yeast to sunlight uniformly lessened catalase activity.

Novikov and Herber ('33) soaked the seeds of the tau-sagyz rubber plant in water for 18 hours and then irradiated them by a mercury arc. The seeds were kept at 25° C. for 2 days and the catalase of the germinated seedlings then determined. The radiation gave an abrupt rise in catalase.

The paper by Fuller ('32) is the only publication to date reporting the effects of raying on the catalase activity of growing plants. Tomato plants and Red Kidney field beans were grown in individual 4-inch pots to a height of about 20 cm. They were then rayed 3 minutes daily for 7 days at a distance of 50 cm. from the arc, the rays being filtered through a layer of 1.5 cm. of water in a quartz cell. Serious injury was produced, as shown by the bronzing and curling of the leaves. At the end of the 7-day period, catalase was determined by a modification of the Appleman method. The averages showed that the catalase activity of the beans had been stimulated 43.2 per cent and that of the tomatoes 49.7 per cent.

2. In vitro studies.—Catalase was studied in its relation to ultra-violet light by *in vitro* studies much earlier than it was approached by *in vivo* methods. It is surprising that the first of these reports was also the first one concerning catalase and ultra-violet in any connection and was carried out by monochromatic radiation. Hertel ('04), in a preliminary study of several sources of ultra-violet, noted the effect of the magnesium line 280 mμ on peroxidase and catalase. In the cata-

lase experiments, he rayed fragments of fungus mycelium, milk, and fibrin. When a drop of hydrogen peroxide was then added, the evolution of oxygen bubbles under the microscope seemed to show that the irradiation had been without effect. But when these substances were rayed in the droplets of peroxide solution, there was a great increase in the evolution of oxygen over that in the unrayed droplets. Since drops of pure peroxide solution foamed when rayed, Hertel correctly assumed that his experiment did not demonstrate increased catalase activity. It is regrettable that his admirably arranged monochromatic irradiation could lead to no significant results because of the very poor method of determining the effect of raying. His results have been quoted by several authors as an indication that catalase activity was increased. A reading of the original paper shows this to be in error.

Catalase preparations from *Dytiscus marginalis* were exposed to sunlight by Ostwald ('08). The activity was determined by titrating the hydrogen peroxide that remained in the test preparation after the lapse of a definite period of time. The enzyme from the larvae exposed to sun used up 94.7 per cent of the available hydrogen peroxide, and the control destroyed 96.8 per cent. While these values show a slight injury to the catalase, it is probable that they are insignificant. The present writers have found that the titration of duplicate aliquots of catalase by the method of Ostwald gives very erratic results unless the amount of peroxide added as a substrate is sufficiently great to insure at least 15 per cent of the original amount still present at the time of titration.

Catalase from rabbit and from human blood was found by Lockemann, Thies, and Wichern ('08) to be greatly injured by 2-hour exposures to strong sunlight. The preparations were exposed while they were reacting with the hydrogen peroxide substrate. Controls containing peroxide alone allowed a correction to be made for the amount of peroxide destroyed by sunlight itself.

The relation of photosensitizers to catalase was studied particularly by Zeller and Jodlbauer ('08). An exposure of 25

minutes to sunlight filtered through water injured the catalase activity 68 per cent if oxygen were present. In the absence of oxygen there was only 10 per cent injury. Exposure to a mercury arc for 30 minutes showed 29 per cent injury if oxygen were present and 25 per cent if absent. These figures show that oxygen is necessary for the injurious action of the visible light and is unnecessary for the ultra-violet. Increasing alkalinity was found to increase the injurious effects of the sunlight, while corresponding increases of acidity up to 1/1500 N sulphuric acid were without effect. The sunlight was increased in its destructive action by 1/5000 N eosin only if the light were passed through a glass plate to remove the short ultra-violet. The eosin had no influence on the irradiation from the mercury arc unless a glass plate was interposed as a filter. Essentially the same results were obtained by the use of sodium-dichloranthracene, methylene-blue, and Bengal-rose.

The injurious waves of the emission spectrum of the fluorescent substances might depend on the nature of the incident light, but why this should be prevented by the mere additional presence of ultra-violet is difficult to explain. It would seem that the destruction of both types of rays should be additive. If, however, the above results are authentic they furnish an interesting instance of antagonism. It is not possible to surmise whether this antagonism is one of physical interference or of physiological reaction.

Some phases of the work of Zeller and Jodlbauer were criticized by Battelli and Stern ('10). They found that the destruction of catalase by the visible sun rays proceeded equally fast in the presence or absence of oxygen. Although the sun can rapidly and completely destroy catalase, a protective action is exerted by traces of alcohol, aldehyde, and certain other chemical agents.

Agulhon ('11) studied the behavior of a number of enzymes to the radiation from a Heraeus mercury arc operating on 110 volts and 2 to 3 amperes. The enzyme preparations were rayed in layers about 1 mm. deep in quartz tubes at a distance of 15 to 20 cm. The activity of catalase obtained from pork fat was

reduced to 83 per cent of the control by an exposure of 1 hour, to 39 per cent in 3 hours, and to 8 per cent in 6.5 hours.

A more complete report was published by Agulhon ('12) the following year. He found, contrary to Battelli and Stern, that catalase from pork liver was destroyed in the absence or the presence of oxygen by visible light, although to a less extent in vacuum, and, in contrast with Zeller and Jodlbauer, he found that the destruction by ultra-violet was notably lessened in vacuum. These inconsistencies were explained by the probable traces of oxygen in evacuated tubes which might be ample to effect the destructive oxidation of the comparatively minute traces of actual enzyme material.

Waentig and Steche ('12) rayed with a mercury arc catalase prepared from fat, liver, blood serum, alcohol, precipitate of blood, larvae of *Sphinx ligustris*, pupae of *S. ligustris*, and from fungi. In all cases the catalase activity was lowered. The injury was small when the raying took place in glass tubes. In some instances, nitrogen was bubbled through the solution for a long time to eliminate the oxygen, but injury was not prevented. It was concluded that the injury was not oxidative, but probably an effect on the solubility of the enzyme, since more or less precipitate accompanied the destruction of the enzyme. Since alkaline solutions increased the injury while acid did not, these authors concluded that probably all catalase reacted the same. Zeller and Jodlbauer found similar results with fat and blood catalase.

The remarkable stability of the catalase activity of red blood corpuscles was demonstrated by Peemöller and Franke ('26). They suspended washed human blood corpuscles in a .9 per cent sodium chloride solution. One cc. of the suspension was added to 10 cc. of 3 per cent hydrogen peroxide, and aliquots of 1.5 to 2.0 cc. were rayed in thin layers at a distance of 50 cm. Under these conditions an 8-minute exposure gave 1 HED (Haut-erythemdosis) unit. Exposures up to 10 HED units (80 minutes) did not produce any significant injury.

It is important to distinguish in studies on the catalase activity of blood between the activity of hemoglobin and that of the blood catalase proper. The great and unexpected stability

of the catalytic action of "Blutkatalase" of Peemöller and Franke is not concerned with the true *enzymatic* activity. This distinction was taken into consideration by Pincussen and Seligsohn ('26). These authors point out that errors due to the activity of hemoglobin can be lessened by proper buffering, since the optimum pH for blood catalase differs from that of hemoglobin.

The experimental preparations of Peemöller and Franke were obtained by adding .02 cc. of blood to 50 cc. of water. Aliquots of 5 cc. of this dilution were mixed with 100-cc. portions of 1/2000 hydrogen peroxide. The reaction was stopped by adding 2 cc. of 20 per cent sulphuric acid. The remaining peroxide was titrated with N/100 potassium permanganate. Aliquots of 25 cc. were removed for titration after 6, 15, and 20 minutes. Irradiation for 20 minutes at a distance of 10 centimeters greatly injured the catalase. This injury was greatest at the pH that is optimum for catalase activity, and was also proportional to the degree of dilution. The presence of potassium iodide and sodium chloride exerted some protective action against destruction of the enzymatic activity by enlarging the colloidal particles sensitive to light.

Sodium chloride was itself injurious in addition to its effect on the light injury. In the presence of this salt, about 50 per cent of the activity was lost on raying for 10 minutes, while in its absence the injury was 25 per cent. The action of potassium iodide is complicated. There is an injury due to the splitting off of free iodine, but in an excess of the salt the protective action of the salt itself exceeds this injurious effect. It is impossible in this instance to clearly distinguish the effect of the salt as a protector, the injurious effect of the halogen ion, and the injurious effect of the liberated iodine. The toxicity of liberated iodine can be demonstrated by raying catalase with alival.

Blood from dogs was exposed in quartz tubes to ultra-violet by Castagna ('27b), and the catalase was progressively inactivated, becoming almost zero after 1½ hours. Sunlight gave a very slight diminution.

Morgulis ('29), working with kidney catalase at various hy-

drogen-ion concentrations, found complete inactivation at all degrees of acidity, but the required time varied. At pH = 6.0, 7.0, and 8.0 the inactivation curves were straight lines as plotted against the time of exposure. At other acidities the inactivation was faster at first, but became slower as the time of exposure increased. The minimum inactivation occurred at pH = 6.0.

This relation to pH was studied further by Morgulis ('30). He disagreed with the opinion of Pincussen that catalase was most injured at its optimum pH = 6.8. Using a Hanovian mercury arc, operating on 110 volts and 5 amperes at a distance of 25 or 50 cm., he was able to show that the greatest injury occurred between pH = 8.0 and 9.0, which is on the alkaline side of the optimum. The stability of his preparation was greatest toward ultra-violet and heat at pH = 6.0, which is on the acid side of the optimum. This pH is suggested as the probable isoelectric point. This paper contains excellent graphs relating activity to pH and time of exposure.

3. Theoretical considerations.—The literature contains a surprisingly great amount of trivial discussion concerning the significance of catalase in tissues. The accumulated authentic data are of permanent value, but their significance is not well understood. A very important statement was published by Pincussen and Tanino ('31), calling attention to two diametrically opposed interpretations of the relation of catalase to respiration. In their study they found a decrease of liver catalase on irradiating the live rats. Assuming that catalase develops proportionally as it is needed to destroy excess hydrogen peroxide, this decrease may be interpreted either as due to an increased oxidation in which hydrogen peroxide is used or to a lessened production of the peroxide by some decreased respirational process.

The paper by Ranjan and Mallik ('31) is one of the most important contributions on the significance of catalase. They show very convincingly that catalase activity parallels the *formation* of hexose, whether this formation results from hydrolysis of disaccharides or from photosynthetic activity.

Wynd ('34) has suggested that this parallelism may signify a transitory peroxide group during the mobilization of the hexose substrate for respiration, and that some of this peroxide is available to peroxidase.

Ostwald ('08), finding that sunlight decreased catalase of larvae when rayed both *in vivo* and *in vitro,* and also incidentally that peroxidase was increased under similar conditions, concluded that these enzymes were connected with phototropism. He also observed that the rayed larvae increased in weight over the controls, but he wisely admitted that these phenomena need not be related necessarily.

The statement of Lockemann, Thies, and Wichern ('08), that the effects of high mountain sun and of sunbaths in general were connected with the depression of the catalase, was made on the unwarranted assumption that *in vivo* effects were similar to those obtained in their *in vitro* raying of blood. The correlation of many apparent discrepancies in the behavior of catalase to irradiation in *in vivo* studies necessitates a consideration of the relative dosages. From the available data it appears that heavy and therefore toxic doses increase catalase of animal tissues while lesser dosages are depressing. The data supporting this generalization are yet comparatively meager and need further verification.

Both of the *in vivo* plant studies show increased catalase. In one instance the rayed seeds produced more vigorous growth, and in the other the growing plants were rayed until they exhibited definite injury. Further data concerning this problem are included in the second paper of this series.

In the *in vitro* studies on animals it is particularly important to separate the catalase activity of hemoglobin and that of the true enzymes, as has been adequately pointed out by Pincussen and Seligsohn ('26). The widely different degrees of injury of catalase solutions by sunlight and by the mercury arc need not be considered incompatible since many known factors, such as dilution, presence of other substances, light intensity, etc., exert powerful influences.

It is clear that catalase is injured by light when irradiated *in vitro.*

B. OXYGENASE

1. Animals.—The general destructive action of ultra-violet on oxygenase of animal origin was reported by Vedder ('24). He found that temperatures greater than 62° C. caused the disappearance of the oxidase-containing granules of leucocytes, but ultra-violet light caused their disappearance in the absence of any temperature change.

The most recent contribution on this subject is that of Wohlgemuth and Sugihara ('25). It had previously been pointed out by Wohlgemuth and Yamasaki ('24) and by Yamasaki ('24) that skin is rich in the enzymes, diastase, lipase, catalase, and oxygenase (phenolase). This oxygenase could oxidize the dihydroxy derivatives of adrenalin, dioxyphenylalanine, and pyro-catechol. Wohlgemuth and Sugihara studied the diastase, lipase, gelatinase, and oxygenase in the skin of different animals and found that oxygenase was highest in the rat and frog. In general, all the animals exhibited greater enzymatic activity of the skin than did man. There was no parallel between the enzymatic content of the blood and that of the skin. Irradiation of guinea pigs over a sufficiently long period with natural sun, artificial sun, and artificial ultra-sun caused a considerable increase of oxygenase, and a decrease of diastase and lipase. In no animal was there any change in the activity of these enzymes in the blood.

2. Plants.—Agulhon ('11) made the observation that the oxygenase (laccase) extracted in glycerin from the fungus *Russula* was extremely stable towards irradiation. Even 6 hours of raying by a Heraeus mercury arc at a distance of 15 to 20 cm. only rarely produced a detectable lessening of its subsequent action on 1 per cent guaiacol. However, if the glycerin extract were diluted with 4 parts of water then oxygenase was notably destroyed in 3 hours of irradiation. Wave lengths longer than 3022 Å were found to be almost inactive.

The following year ('12) he published a more extended report. The method of raying was similar to that of his earlier work, and from the identity of the numerical data it may be

inferred that the previously obtained data were the basis of his later paper. Besides restating the observations of his earlier paper, this publication describes a possible mechanism for the action of the ultra-violet rays. Since oxygenase is not attacked in a glycerin extract in vacuum, and but a slight decrease becomes apparent when the glycerin extract is diluted with water, it is therefore probable that the destructive action is one of oxidation.

It is known that ultra-violet light decomposes water to a slight degree, liberating hydrogen. In the presence of oxygen, this hydrogen forms hydrogen peroxide, which injures the enzyme. Experiments showed that .5 per cent hydrogen peroxide destroys completely the oxygenase of *Russula* extracts in 4 hours. Visible light was thought to owe its destructive action to the same mechanism, although in this instance actual air was necessary, while with the ultra-violet the slight traces of oxygen unavoidably present in vacuum sufficed.

3. Theoretical considerations.—Because of the small amount of work done on the behavior of the oxygenases to ultra-violet, it is difficult to arrive at definite conclusions. If the interpretation of Agulhon is verified, then it forms a significant basis upon which we may interpret various of the activities of ultra-violet light. The authenticity of the formation of hydrogen peroxide by the action of ultra-violet on water is undoubted, but whether this could act destructively on the oxygenases is a question, although the fact that .5 per cent hydrogen peroxide completely inhibited *Russula* oxygenase in 4 hours cannot be ignored. More discussion of the problem will follow in the theoretical consideration of peroxidase.

The work of Wohlgemuth and Sugihara is suggestive, since it is not impossible that the oxygenase increase in the skin of rayed animals might play a role in the development of melanin in spite of the fact that the specific enzyme preparation used in these experiments did not affect tyrosine. The distinction between oxygenase and the tyrosinase may be assailed on theoretical grounds, and the entire problem of the nature of the ac-

tivity of oxygenase and tyrosinase is not as firmly supported as many writers suppose. A review of this interesting problem is not appropriate in the present paper.

C. TYROSINASE

1. Animals.—Narayanamurti and Ramaswami ('29, '30) irradiated the larvae of *Dolichos* and found consistently increased tyrosinase activity of extracts.

It was shown by Lignac ('30) that human skin, after death, would develop melanin as a result of raying with a Kromayer mercury arc. Several hours of exposure of dead skin were needed to produce the same degree of pigmentation as an exposure of 4 minutes of live skin. The difference was attributed to the constant oxygen supply of live skin. One might assume very reasonably that the increase of melanin in skin after raying is due to an increase of the activity of tyrosinase. Pincussen and Hammerich ('31a), acting on this supposition, modified the method of Raper and Wormall for the estimation of tyrosinase, so that it could be used as a micro method. Enzymes prepared from meal worms were rayed *in vitro* with a mercury arc. Tyrosinase, as most other enzymes, was greatly injured, and they concluded that the formation of melanin in the skin by ultra-violet was not due to an increase of tyrosinase.

2. Plants.—The papers of Agulhon ('11, '12), mentioned above, state that the extracts from *Russula* contain tyrosinase and that this enzyme is more stable towards irradiation than is oxygenase. Like oxygenase, it was not destroyed by ultraviolet in glycerin in vacuum, and only slightly injured when rayed in a water solution in vacuum. Likewise, it was inactivated in 4 hours by .5 per cent hydrogen peroxide. It was thought to be destroyed by the same mechanism as suggested for oxygenase.

3. Theoretical considerations.—The conclusions of Pincussen and Hammerich may be attacked on several grounds. In the first place, as has been clearly demonstrated by Fuller ('32), the behavior of an enzyme under *in vitro* raying bears no relation to its behavior when rayed *in vivo*. Moreover, the

total exposure, 1 hour at 50 cm., might well have obscured the effect of less toxic exposures. But the most arresting fact of all is that these authors used dioxyphenylalanine, as well as tyrosine, as a substrate, with identical results. Wohlgemuth and Sugihara found that dioxyphenylalanine was oxidized more by the skin oxidase (called phenolase by them) extracted from guinea pigs which had been rayed while living with a mercury arc. Since enzymes are defined in terms of their substrates, it may be assumed that whatever enzymes actually attack this particular substance, they reacted differently to *in vivo* and *in vitro* irradiation. These authors did not, however, obtain any oxidation of tyrosine by their skin extracts, and yet we know that tyrosinase should have been present in the fraction which they called "phenolase." As mentioned above, the oxygenase and tyrosinase reactions are surprisingly complex and confused in the literature.

It seems reasonable to conclude that tyrosinase, as most enzymes, is injured by irradiation *in vitro,* but that its behavior *in vivo* to exposures has not yet been reported authentically.

D. PEROXIDASE

1. Animals. a. Milk.—The paper of Hertel ('04), already cited as the earliest study on the effect of ultra-violet on catalase, occupies a similar position in respect to peroxidase. Milk peroxidase was studied by mixing 2 cc. of fresh milk with 2 cc. of .1 per cent aqueous solution of guaiacol and 1 drop of hydrogen peroxide. Irradiating the milk with the 2800 Å magnesium line produced a notable diminution of activity even with as brief exposures as 5 minutes.

Römer and Sames ('10) materially extended the observations of Hertel. They used 5 cc. of cow's milk mixed with 2 drops of guaiacum tincture and 6 drops of 2 per cent hydrogen peroxide. If the milk were rayed with a Heraeus mercury arc at a distance of 15 cm. for 1 hour, the peroxidase activity was completely inhibited. Exposures of ½ hour allowed a positive test to appear, although less than the control. When milk whey was rayed, a trace of peroxidase activity remained after 1 hour of exposure, but 1¼ hours were completely inhibitory. These

authors state that this destruction of the peroxidase (called "oxidase" by them) could have no hygienic significance in infant feeding, since human milk normally contains no peroxidase.

In view of the great similarities between cow's milk and human milk, it seems strange that such a difference could exist in this particular. Asakura ('32) has shown that human milk lacks peroxidase if it also lacks vitamin B. Heavy feeding of vitamin B causes the peroxide reaction to appear.

Reinle ('21) extended the study of the peroxidase of cow's milk to include the effect of Röntgen rays, the γ-rays from radium chloride, and ultra-violet. The X-rays and γ-rays had no effect. When the milk was rayed with a mercury arc operating on 110 volts and 4 amperes at a distance of 15 cm., there was a temporary increase for the first 20 to 30 minutes. This stimulation is not significant since mere warming of the milk will also give this effect. This apparent stimulation could not be due to the destruction of the dehydrogenase system by the irradiation, since, as will be shown later, these enzymes are notably stable towards ultra-violet. The effect of warming could very well depend, on the other hand, on the inhibition of dehydrogenating systems. Such an effect has been suggested by Keilin ('29) to account for the fact that fresh baker's yeast exhibits no peroxidase test while warmed yeast does.

1. Animals. b. Tissue.—The relationship between animal tropisms and the light-sensitive enzymes was studied extensively by Ostwald ('08). He found that strong sunlight increased the peroxidase activity of extracts from the larvae of *Porthesia chrysorrhoea.* Irradiation of the living larvae also produced the increase, from which it was concluded that phototropism was connected with cellular respiration. The peroxidase activity of irradiated Paramecia was studied by Roskin and Schischliajewa ('34), but no conclusive results were obtained.

2. Plants. a. In vivo studies.—There have been no data reported on the effect of raying living plants on the activity of

peroxidase. The authors report studies of this problem in the next number of this series.

2. Plants. b. In vitro studies.—The effects of strong sunlight were reported first by Bach ('08). The preparations were exposed in Erlenmeyer flasks, and hence only the longer ultra-violet reached the solution. The exposures lasted from 4 to 76 hours, with a progressive decrease in the activity of the enzyme.

Jamada and Jodlbauer ('08), in an extensive study on the effect of irradiating peroxidase of vegetable origin, reported that horseradish peroxidase was injured by 15-minute exposures to sunlight even when the light was filtered through 20 cm. of water to remove the infra-red. The injurious effect of ultra-violet was shown by the fact that the activity of the enzyme was lessened more by 25-minute exposures to sunlight filtered through quartz than through ordinary glass. Exposures to a mercury arc with 20 cm. of water used as a filter were made. When ordinary glass was interposed there was some injury, but when a quartz plate was substituted the injury was very marked. It was also shown that the visible portion of the spectrum, either from the sun or from a mercury arc, had no effect in the absence of oxygen. The rays from an unscreened mercury arc gave great injury in absence of oxygen, which was a little increased if oxygen were present. From these data the authors concluded that ultra-violet exerted its injurious effect by a fundamentally different mechanism than did the visible light. If eosin were present in concentrations of 1/2000 to 1/5000 N, the peroxidase was sensitized notably towards the visible light. The results after 75 minutes were:

Control.............	0 per cent injury
Rayed..............	41 per cent injury
Rayed with eosin....	58 per cent injury

This paper contains excellent data illustrating the fact that fluorescent substances may act as sensitizers by changing incident light to more harmful wave lengths, or they may act as protectors by degrading toxic to harmless wave lengths. Thus,

in the present study, eosin and Bengal-red (1/10,000 N) sensitized peroxidase to the visible light, when methylene-blue and the sodium salt of dichloranthracene-disulphuric acid protected the enzyme. In the case of methylene-blue, the injury by visible light was lessened 50 per cent. Eosin in the ultra-violet had no sensitizing action. In the absence of the visible rays, it had a protective influence against ultra-violet, since it absorbed some of the toxic waves and rendered them harmless. In the absence of oxygen the visible could not act, hence eosin also protected.

The fact that Karamitsas ('07) found that eosin did not significantly sensitize peroxidase may be due to his use of thinner glass tubes. If the ultra-violet were transmitted, then eosin would exert a protective action toward these waves which might cancel the added destructive power of the visible, thereby giving the false appearance of inaction on the part of the fluorescent compound.

Bering ('12) reported a stimulation of horseradish peroxidase by irradiation. Exposure to strong sunlight in dosages of .7 to 1.0 "Finsen" units stimulated the subsequent formation of purpurogallin about 6 per cent. The unscreened mercury arc gave only inhibition, but when filtered through a rabbit's skin the rays stimulated peroxidase again about 6 per cent. Experiments with filters showed that the red region of the spectrum had no effect; the yellow and also the green regions were stimulative; the blue plus the long ultra-violet stimulated about 12 per cent. The author concluded that those rays which penetrate the skin stimulate the respiratory enzymes and therefore are physiologically important. Later Bering and Meyer ('12a, b) verified these results, and pointed out that ultra-violet filtered through rabbit's skin stimulated or inhibited peroxidase, depending on the concentration of the enzyme. The unfiltered sunlight stimulated when the exposure was short.

Capelli ('26) rayed a purified vegetable peroxidase and found the mercury arc injurious. The solutions developed ozone which may have caused an initial apparent increase in

oxidative power. During this same year, Meyer ('26) published a review in which he restated the belief that light activated the oxidizing enzymes, and was of therapeutic value on that account. New data were given verifying the stimulation of peroxidase by exposure to the mercury arc, but only when the shorter irradiations were removed by a rabbit's-skin filter.

Pincussen and Hammerich ('31b) prepared a very concentrated horseradish peroxidase according to the method of Willstätter. They mixed .4 cc. of the preparation with .2 cm. of .5 per cent hydrogen peroxide, and then diluted to 400 cc. with water containing 1 gm. of pyrogallol. Aliquots of 20 cc. were removed for the determination of purpurogallin. The reaction was stopped by adding 10 cc. of 10 per cent sulphuric acid. The color was extracted by 20 cc. of ether, and the ether solution compared colorimetrically with a .57 per cent solution of chromic acid. The enzyme solutions were diluted with 5 parts of water. Acetate buffers were used to obtain pH = 3.4, 4.0, 4.6, 5.2, 6.0, and 6.4. The exposures lasted 30 and 60 minutes. The light source was a "Vitaluxlampe" mecury arc with a glass cell to filter out the heat rays. The enzyme was greatly injured by irradiation. The pH had no great influence on the degree of injury, although there was a greater diminution of activity when the solutions were acid.

3. Theoretical considerations.—The effect of raying on peroxidase is subject to several sources of error. The ability of ultra-violet rays to produce hydrogen peroxide in water has been demonstrated by a number of students among whom we may mention Tian ('11). If sub-optimum concentrations of peroxide are used in experiments, this additional substrate for the enzyme may cause an increase in oxidation. This is especially true of oxygenase, in which the slight amount of peroxide formed would enable the otherwise inactive peroxidase to act, obscuring the activity of oxygenase itself. Peroxides may also develop when oils are irradiated, as has been worked out by Delore ('29) and others. These peroxides not only act as an additional source of substrate for the enzyme, but also cooperate with ultra-violet on their own account to ac-

complish oxidation of the dye indicator. The peroxide also is destroyed by ultra-violet, and Koeppe ('30) has shown that the liberated oxygen is in the nascent condition and easily oxidizes guaiacol. The oxygen that develops when hydrogen peroxide is decomposed by heat does not oxidize guaiacol. From Koeppe's data, it is seen that false results may be obtained if the enzyme is irradiated in the presence of the indicator.

The influence of ultra-violet on tautomeric equilibria is well known. It is not improbable that substances which exist in a keto-peroxide tautomeric equilibrium may have oxidative powers due to this fact when affected by irradiation. The existence of an enol and a keto-peroxide form in cholesterin is particularly significant, since Remesow ('32) has shown that this keto form interferes, because of its oxidative power, with the conventional Nadi test for oxygenases.

Pincussen ('30), in the most adequate discussion that has appeared concerning the physiological effects of ultra-violet, has pointed out that the mechanism of color formation in the peroxidase tests is very complex, and that the observed stimulation may not be connected with the enzyme itself. From the discussion above, it is seen that this is indeed probable.

The few instances of stimulated peroxidase activity resulting from irradiation are probably due to some of the disturbing factors discussed above. The theory that light, particularly ultra-violet, owes any of its physiological effect to stimulated oxidizing enzymes is to be disregarded. It is not known whether the thermo-stable peroxidases react differently than the labile type.

E. DEHYDROGENASE

1. *Animal tissues.*—Krestownikoff ('27) prepared a dehydrogenase solution from horse muscle, using potassium succinate as the hydrogen donater. Evacuated tubes containing the enzyme-succinate-methylene blue mixture were rayed in a water bath by a carbon arc. Since glass tubes were used, only the longer ultra-violet reached the solutions. Exposure to the carbon arc stimulated the rate of reduction of the methylene-

blue. Control solutions containing no enzyme showed no reducing power.

Junghagen ('28) found that the succinic-acid and glycerophosphoric-acid dehydrogenases extracted from horse muscle were rapidly destroyed by ultra-violet irradiation. Bertraccini ('29) found that dehydrogenase of animal origin, as studied by the reduction of m-dinitrobenzol, was increased by small exposures to ultra-violet, but depressed by larger doses.

The work of Palmieri ('33) was more extensive. He rayed rabbit eyes for various periods, and then studied the reducing power of the lenses by Thunberg's method. Immediately after raying, there was a slight increase in the rate of reduction of methylene-blue, followed by a decrease, and finally, 3 days after the irradiation there was a progressive increase.

2. Plants. a. Bacteria.—The only data concerning the behavior of bacterial dehydrogenases depend on inferences drawn from the work on *Bacillus coli,* already quoted, by Cook and Stephenson ('28). These authors studied the relation of the viability of the cell to its ability to oxidize aerobically glucose and its fermentation products. Cell suspensions exposed 20 minutes to a mercury arc contained but 2.74 living cells per 1000, and exposures of 30 minutes killed all but 2 per 1000. The substrates used were glucose, acetate, lactate, and formate. When glucose was the substrate, the cells rayed 20 minutes showed only about one-half as much oxygen use after a period of 30 minutes, but after one hour the total oxygen use was about equal to the control. The same was true of lactate and acetate, and only in the case of formate was an undoubted inhibition of oxygen use evidenced. The authors concluded, as has been mentioned above, that no significant difference was found between the oxidation of dead and living cells. It should be mentioned, however, that the objections to their technique, already described, are pertinent also to this interpretation.

2b. Higher Plants.—The dehydrogenases of plants have not been as well studied as those of animals, and therefore the extensive paper by Lehmann ('22) is of particular importance.

The seeds of *Phaseolus vulgaris* were ground very fine and .05 gm. placed in Thunberg tubes. Besides the meal, each tube received .1 cc. of 1/5000 methylene-blue, .1 cc. of 1/10 N potassium biphosphate as a buffer, .5 cc. of potassium malate as a hydrogen donator. Water was added to give a total of 1 cc. The potassium malate solution was made by dissolving 346 mgms. in 10 cc. of water. The tubes were evacuated and the time required for the reduction of the methylene-blue recorded. The dry powder was rayed with a carbon arc at a distance of 40 cm., with the following results:

Control	required 21 minutes for reduction
Rayed 100 minutes....	required 19 minutes for reduction
Rayed 240 minutes....	required 43 minutes for reduction

It is significant, as will be pointed out later, that a stimulation occurred when the sample was rayed 100 minutes.

3. *Xanthine dehydrogenase.*—Some authors consider the aldehyde oxidizing system in milk to be catalyzed by an enzyme distinct from that concerned in the oxidation of xanthine. It seems logical that substrates differing from each other as greatly as do aldehyde and xanthine should be activated by different enzymes. Most writers believe, however, that a single enzymic system is concerned.

Römer and Sames ('10), in the paper referred to above, reported the effect of raying cow's milk on the dehydrogenase (reductase). They used methylene-blue as an indicator in the presence of formaldehyde. Exposures to a Heraeus mercury arc at a distance of 15 cm. for various periods gave a small increase at shorter exposures and then a decrease, although even 2 hours of irradiation did not completely destroy the enzyme, as is shown by the table:

Control	reduced methylene-blue in 6 minutes
Rayed ½ hour......	reduced methylene-blue in 4 minutes
Rayed 1 hour.......	reduced methylene-blue in 6 minutes
Rayed 2 hours......	reduced methylene-blue in 30 minutes

This same reaction was studied by Reinle ('21) and the resistance of the dehydrogenase to ultra-violet verified. His abbreviated results are:

Fresh milk.......	reduced methylene-blue in	7½ minutes
Rayed 10 minutes.	reduced methylene-blue in	8 minutes
Rayed 30 minutes.	reduced methylene-blue in	12 minutes
Rayed 1 hour.....	reduced methylene-blue in	15 minutes
Rayed 2 hours....	reduced methylene-blue in	19½ minutes
Rayed 3 hours....	reduced methylene-blue in	24 minutes
Rayed 4 hours....	reduced methylene-blue in	31 minutes

Injurious effects of the same order of magnitude were again obtained by Pincussen and Oya ('29). They mixed 1 part fresh cow's milk with 1 part of M/3 phosphate buffer and 1 part of water, and added 5 cc. of this mixture to .3 cc. of a methylene-blue solution. The methylene-blue solution was prepared by mixing 5 cc. of saturated alcoholic methylene-blue with 5 cc. of formalin, and diluting to 200 cc. with water. The milk-buffer mixture was rayed in thin layers at a distance of 20 cm. from a mercury arc for 1 hour. The dehydrase (aldehydrase) was weakened about 50 per cent.

Bernheim and Dixon ('28) studied the effect of light on xanthine oxidase of fresh milk, the caseinogen preparation of Dixon and Thurlow, and on the whey preparation of Dixon and Kodama. Hypoxanthine or aldehyde were the hydrogen donators, and methylene-blue or nitrate were the hydrogen acceptors. The reduction of the methylene-blue was followed in Thunberg tubes. Moderate irradiation by a carbon arc or by a 100-watt filament bulb gave great stimulation when traces of oxygen were present. Long exposures were inhibitory. Both of these effects were found to be due to the formation of traces of hydrogen peroxide. The first stage of oxidation of the oxidase by the peroxide caused an increase in its activity, while its further oxidation lessened its activity. This interpretation is made probable by the fact that 1/100,000,000 M hydrogen peroxide gave stimulation. Higher concentrations than these destroy the enzyme. The intensity of the effect depends on the amount of enzyme present.

4. *Theoretical considerations.*—It is interesting to note that small increases of dehydrogenating activity, when the period of irradiation was short, were observed in milk by Römer and Sames and by Krestownikoff, and in animal tissues by Bertraccini, by Krestownikoff, and by Palmieri.

Despite the few published papers on the subject, it is evident that dehydrogenases are particularly resistant to ultra-violet destruction. It would be interesting to compare the resistance of the oxidases under similar *in vivo* conditions. The work on xanthine dehydrogenase (known more commonly as "xanthine oxidase") furnishes the most convincing evidence at hand of the stimulation of an oxidizing enzyme by ultra-violet light. The fact that methylene-blue can act as the hydrogen acceptor in the absence of oxygen, and that formaldehyde can be substituted for xanthine or hypoxanthine as the hydrogen donator suggests an explanation for the several instances of dehydrogenase stimulation described above. In many of these experiments, the preparations, particularly those of indefinite composition, may have been exhibiting the typical xanthine-oxidase reaction rather than that of the supposed dehydrogenases. This seems the more probable when it is recalled that xanthine and its derivatives, and xanthine- activating systems, are widely distributed in nature.

Meldrum ('33) has summarized the characteristics of this interesting enzyme. He points out that it differs from the usual dehydrogenases in that the dehydrogenase inhibitors, such as vanillin, urethane, diethylurea, propionirile, etc., do not lessen its activity, nor is it inhibited by hydrogen cyanide or hydrogen sulphide. It contains neither cytochrome nor an oxidase. From these facts it is seen that the enzyme is fundamentally different from dehydrogenase of the succinate dehydrogenase type.

V. Sulphydryl Compounds

A. EXPERIMENTAL

The first reversibly oxidizable substance of known composition to be isolated from tissues was glutathione. In later years

it has assumed great importance in respiration chemistry, although comparatively few students have studied it in connection with the problems of ultra-violet biology.

Glutathione bears an intimate relationship to many enzyme systems, and it has also been considered to be a factor concerned in the proliferation of cancer tissue. In view of the effect of raying cancer tissue with ultra-violet, Woodward ('33) irradiated glutathione in pure solution. She used a Uviarc at a distance of 25 cm., and irradiated the solution in thin layers on an ice bath to eliminate destruction by the heat. The destruction of the glutathione, as well as the oxidation of sulphydryl group generally, was found to depend on the pH, on the time of exposure, and on the concentration of the sulphydryl compound. At pH = 7.0, the oxidation of the sulphydryl compound to the disulphide proceeded more rapidly than destruction, and this process is therefore probably a primary step in the destructive effect of ultra-violet on glutathione. The destruction seemed to be a progressive oxidizing effect rather than the liberation of inorganic sulphide or free sulphur.

Bersin ('33) based his study of the sulphydryl compounds on the fact that papain had been shown to be activated by hydrogen sulphide or by such thiol compounds as cystein or glutathione. This activation involves a reduction. In opposition to Woodward, Szendro had shown that cystein developed from cystine when exposed to ultra-violet light. The work of Szendro was repeated by Bersin ('33) and found to be correct. He rayed the substance, $HOOC.CH(CH_3).S.S.C(CH_3).COOH$ and found that it went to the reduced form. This experiment took place in a hydrogen atmosphere, while Woodward irradiated her solution in air. Bersin assumed that papain was a disulphide, PaSSPa, which became activated when reduced to the PaSH form by irradiation in hydrogen.

Pincussen and Takahashi ('33) removed the organs from animals 30 minutes after raying them and determined their gluthathione content. These authors irradiated with infrared, blue, orange-red, and yellow. The latter was obtained by a sodium-vapor lamp and a significant amount of ultra-violet

was present. The sodium lamp produced in general a small increase in the glutathione content, with no significant difference when the ultra-violet was removed by filtration.

Wels and Jokisch ('33), Wels ('33), and Wels and Hesse ('34) have shown that egg albumen when rayed in nitrogen with ultra-violet developed a reversibly oxidizable body, probably a sulphydryl compound. It is very probable that irradiation of living tissue produces some similar result which cannot but be of importance to the respiratory processes.

B. THEORETICAL CONSIDERATIONS

The apparently contradictory results of Woodward and Bersin are to be explained by the fact that Woodward rayed her solution in air, while Bersin used a hydrogen atmosphere. Wels and his co-workers state that when egg albumen is rayed in air, the oxidized form of the reversible oxidizable body occurs, while in nitrogen it is the reduced form.

This difference of effect, depending on the presence of oxygen, has a possible explanation in the fact that ultra-violet rays cause water to split off hydrogen in small quantities. If air be present, then hydrogen peroxide results, and this peroxide is responsible for an oxidizing effect. In the absence of oxygen, this "active" hydrogen could be taken up by any reducible body, causing reduced forms to develop. While these reactions undoubtedly occur, there is also the direct effect of the ultra-violet itself to be considered. Hence, the ultra-violet may cause the reversibly oxidizable body to develop from protein, but the presence or absence of oxygen would determine, by the above suggested mechanism, whether this substance would appear in the oxidized or reduced state.

VI. CONCLUSIONS

A review of the published data concerning the effect of ultra-violet on oxidizing enzymes *in vitro* shows, with the exception of xanthine oxidase, generally destructive effect. Agulhon ('12) has described three classes of enzymes depending on the part that ozygen plays in their photodestruction.

1. Invertase, oxygenase (laccase), and tyrosinase are destroyed only in the presence of oxygen by visible rays and are less rapidly attacked by ultra-violet in vacuum, the rapidity depending on the amount of hydrogen peroxide that develops.

2. Catalase and emulsin are destroyed in vacuum by all radiations, but less actively in vacuum than in oxygen.

3. Rennet is insensible to the visible radiations, but is attacked by ultra-violet with equal intensity in vacuum and in oxygen.

Are these three classes of enzymes dependent on their inherent differences, or are these divisions only apparent, depending on some activity of impurities, or on the nature of the substrate? To these questions Agulhon wisely replies that the present state of knowledge is too incomplete to allow definite answers.

The various degrees of injury reported by different workers are not to be considered as inconsistent nor surprising, since many factors both known and unknown are cooperating to give the finally observed effect. This is particularly true of studies carried out *in vivo.*

Despite the efforts of a few writers to correlate physiological phenomena due to raying with the effects on individual enzymes, it may be said that such correlations are based upon very insecure evidence. The profound difference between raying enzymes *in vivo* and *in vitro* itself argues against any such conclusion. The few data reporting similar reactions *in vivo* and *in vitro* of peroxidase and catalase require further verification.

Finally, we must conclude that it is not possible at the present time to analyze the effect of ultra-violet light on respirational metabolism into its various components.

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STUDIES IN ULTRA-VIOLET AND RESPIRATORY PHENOMENA. II

The Effects of Ultra-Violet on Respiration and Respiratory Enzymes of Higher Plants[1]

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The present paper reports observations on the respiratory rate and activity of oxidizing enzymes of tomato and bean plants as affected by ultra-violet radiation, and offers suggestions concerning the relationship of oxygenase and peroxidase to the respiratory mechanism. The pertinent literature has been discussed in the first paper of the series (Wynd and Reynolds, '35).

EXPERIMENTAL METHODS

From several hundred plants of Bonny Best tomatoes and Red Kidney field beans, those of uniform size and vigorous physiological condition were selected. They were irradiated under the conditions of the individual experiments by a Burdick quartz mercury vapor arc suspended above the plants. The distances reported were measured from the arc to the surface of the soil. Two types of filters were used: one a quartz-plate

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tray 5 mm. thick, containing 2 cm. of distilled water; the other, a tray made of Vita glass, containing a similar depth of water. The quartz water cell, according to Jones ('28), absorbs all wave lengths longer than 1.4 μ, and the Vita glass water cell eliminates not only this infra-red but also the ultra-violet shorter than 2894 Å.

Respiration was determined by weighing the amount of carbon dioxide eliminated per gram of fresh weight over a given period (Wynd, '32, '35). The intrinsic accuracy of this apparatus is very great. However, the respirational rates of the plants themselves were found to vary about ± 5 per cent in duplicate controls, and so this must be regarded as the maximum accuracy of the data obtained. The plants were cut off at the surface of the soil in the evening and placed in beakers of water in the respiration chambers, and the next morning the carbon dioxide absorption bulbs were weighed. Five plants were used for each determination, and observations on the control and the experimental plants were carried on simultaneously.

Since all of the enzymatic determinations were made on juice pressed from the plants *after* they had been rayed, the values obtained represent *in vivo* reactions. The necessary distinction between *in vivo* and *in vitro* experiments has been particularly pointed out by Fuller ('32) and by Wynd and Reynolds ('35). The upper leaves and the upper 2 inches of the stems were ground to a paste in a mortar with a little quartz sand, then squeezed through 2 layers of cheese-cloth, and aliquots of this solution used for the enzymatic determinations. Since the usual methods of measuring acidity are disturbed by oxidizing enzymes or by hydrogen peroxide, the final pH of all experimental solutions was checked by the glass electrode.

Extended experimentation by Wynd has shown that the determination of catalase activity can be more closely duplicated by titration than by gasometric methods. However, the gasometric method is entirely satisfactory as a *micro* procedure if the usual precautions are taken. Experiments involving relatively large amounts of material can be duplicated by titration with an error of 1 or 2 per cent, which is not possible by *macro* gasometric procedures. The experimental solutions contained

50 cc. of phosphate buffer at pH = 7.00, 20 cc. of 3 per cent commercial hydrogen peroxide, and 1 cc. of the expressed juice. The reaction time varied from 8 to 20 minutes in the different experiments, and it was stopped by adding 20 cc. of a 25 per cent solution of sulphuric acid. The time of adding the plant juice and of the subsequent addition of acid was carefully controlled by a stop watch. The amount of hydrogen peroxide remaining was then titrated with N/5 potassium permanganate. The reaction times of all the solutions were spaced 1 minute apart to allow time for the pipettings.

Peroxidase was determined by the method of Guthrie ('31). The substrate for the enzyme was prepared by adding 200 cc. of a citrate buffer at pH = 4.5 to 200 cc. of water. To this were added 1 gm. of p-phenylenediamine hydrochloride and 20 cc. of a 4 per cent solution of alpha-naphthol in 50 per cent alcohol. The final mixture was filtered and used immediately. At pH = 4.5, atmospheric oxidation of the substrate is slow, and catalase is so far depressed as not to seriously interfere. The experimental solutions consisted of 25 cc. of substrate, 1 cc. of commercial 3 per cent hydrogen peroxide, and .5 cc. of the plant juice. After 10 to 20 minutes, depending on the intensity of the color which developed, the reaction was stopped by the addition of 5 cc. of a .1 per cent potassium cyanide solution. Since the cyanide inhibits the enzyme but does not interfere with the atmospheric oxidation, the indophenol produced was determined as quickly as possible. This was done by shaking each experimental mixture with 50 cc. of toluene until the water layer was clear. The upper layer of toluene, after being poured off and centrifuged to remove bubbles and tissue fragments, was examined in a colorimeter. The error of this method is about 3 per cent.

Oxygenase was determined similarly to peroxidase except that the hydrogen peroxide was not added to the substrate. Due to the feeble activity of oxygenase as compared with that of peroxidase, 1 cc. of plant juice was used for each determination, and the reaction time was usually extended to 20 minutes. The indophenol was extracted in 25 cc. of toluol. The error of this method is about 3 per cent.

Since the temperature, reaction periods, etc. varied from day to day, the absolute values of data obtained at different times may not be directly compared, and the tables contain values calculated as percentages of their corresponding controls. These percentage values obtained at different times may be compared directly. In the figures, the numbers on the ordinate represent the per cent of stimulation or depression, the graphical value of the control therefore being zero. The horizontal line at zero divides the stimulation from the depression values. The numbers on the abscissa represent minutes of daily exposure.

EXPERIMENTAL RESULTS

Experiment I.—Bonny Best tomato seeds were planted in greenhouse flats January 23, 1934, and were transplanted to 4-inch pots February 8. The raying began March 4, and was continued daily for 5 days. The distance was 24 inches and the dosages 4, 8, 16, and 32 minutes daily. The unscreened mercury arc was used as a source of illumination.

TABLE I

ENZYMATIC ACTIVITY OF TOMATO PLANTS RAYED AT 24 INCHES WITH THE UNSCREENED MERCURY ARC, CALCULATED IN PERCENTAGES OF THE CONTROL

	Control	Daily Dosage			
		4 minutes	8 minutes	16 minutes	32 minutes
After 5 days of irradiation					
Oxygenase	100	96	107	96	78
Peroxidase	100	97	159	166	213
Catalase	100	123	134	119	125
5 days after irradiation ceased					
Oxygenase	100	95	92	88	74
Peroxidase	100	189	263	345	385
Catalase	100	115	146	194	165

All plants showed definite injury at the end of the 5-day period of irradiation. The plants submitted to the heavier

dosages were very severely burned. One set of determinations was made at the end of the irradiation period and another 5 days later. The plants were not rayed during this intervening period. From table I and figs. 1 and 2, it is seen that with increasing amounts of daily irradiation the peroxidase activity greatly increased. Catalase also increased but less than the

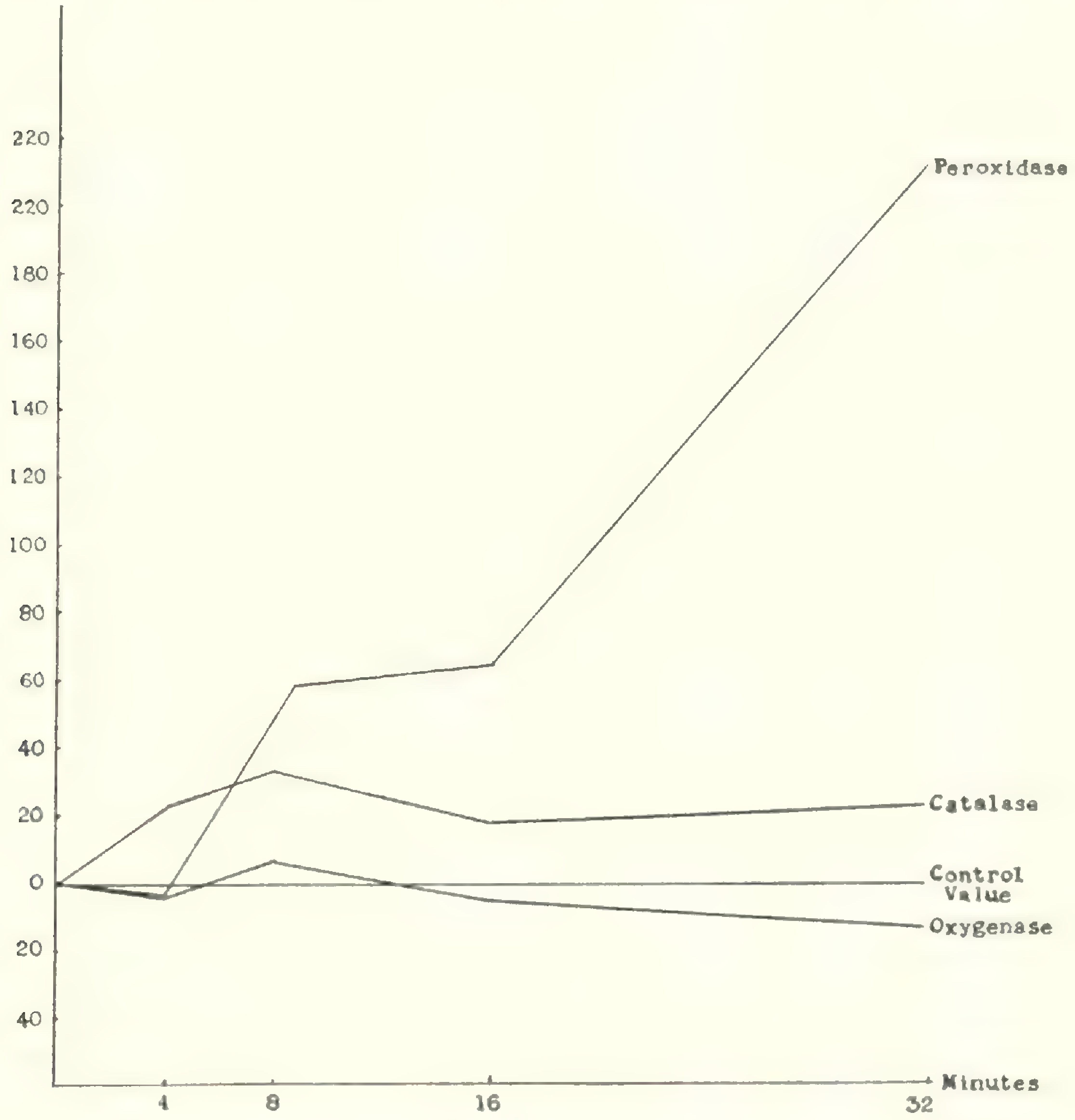

Fig. 1. Determination of enzymatic activities of tomato plants after being irradiated daily for 5 days at 24 inches, through quartz water-cell filter.

peroxidase, while oxygenase was progressively inhibited. These results were of greater magnitude 5 days after irradiation ceased.

Experiment II.—Bonny Best tomatoes were planted February 15, 1934, and transplanted from the flats to 4-inch pots on

April 5. The raying began April 16, at a distance of 100 inches, and continued in 10-minute doses daily for 5 weeks. According to Fuller ('31), these are the optimum conditions for growth stimulation. Some of the plants were rayed through the quartz

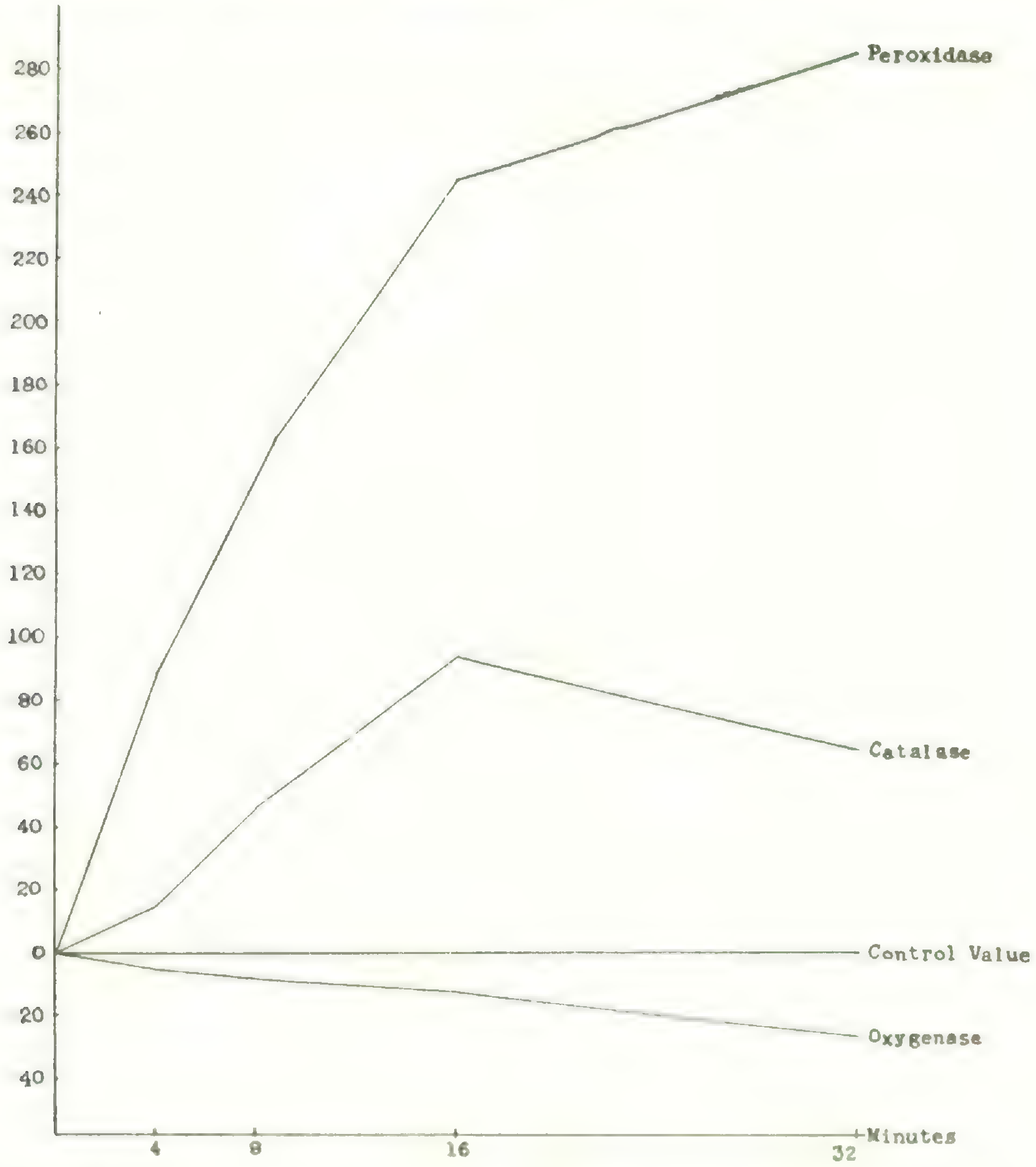

Fig. 2. Determination of enzymatic activities of tomato plants 5 days after irradiation ceased.

water cell, and others through the Vita glass water cell. Two determinations of enzymes and respiration were made on consecutive days at the end of the period of irradiation.

The data in table II, graphically represented in fig. 3, indicate that the plants rayed through the Vita glass water cell

TABLE II

RESULTS OF IRRADIATING 5 TOMATO PLANTS AT 100 INCHES FOR 10 MINUTES DAILY FOR 5 WEEKS, CALCULATED IN PERCENTAGES OF THE CONTROL

Treatment	One day after irradiation ceased						
	Fresh wt. in gms. of tops		CO_2 elimination		Relative percentage of enzymatic activity		
	Actual	Relative	Per gm. fresh wt.	Relative	Catalase	Oxygenase	Peroxidase
Control	95.6	100	.00098	100	100	100	100
Rayed through Vita glass water cell	107.5	112	.00128	131	164	104	100
Rayed through quartz water cell	93.5	98	.00102	104	190	117	103
	Two days after irradiation ceased						
Control	84.5	100	.00200	100	100	100	100
Rayed through Vita glass water cell	102.0	121	.00218	109	142	103	100
Rayed through quartz water cell	90.0	107.0	.00208	104	118	106	102

were stimulated in growth from 12 to 21 per cent. Since only 5 plants were used for the determination, this result is not statistically significant, but there is qualitative agreement with the results published by Fuller ('31) on the stimulation of growth under these conditions. Respiration is also increased. Catalase showed a very great increase, while oxygenase was but slightly increased, and peroxidase was not affected. The variations given for oxygenase probably are not far beyond the experimental error. There was qualitative agreement between the data obtained on successive days, and consequently on different samples of tissue.

Irradiation through the quartz water cell, which allows much of the short, injurious ultra-violet rays to pass, had no con-

sistent effect on growth, although, as noted above, the number of plants was too small to present convincing evidence. Respiration was stimulated only slightly, less than when the Vita glass water cell was used as the filter. Again catalase was greatly stimulated, while oxygenase showed a smaller increase. Peroxidase was slightly increased, although the increase is too close to expect experimental error to be accepted as significant. It is thus seen that the physiological effects of rayings through

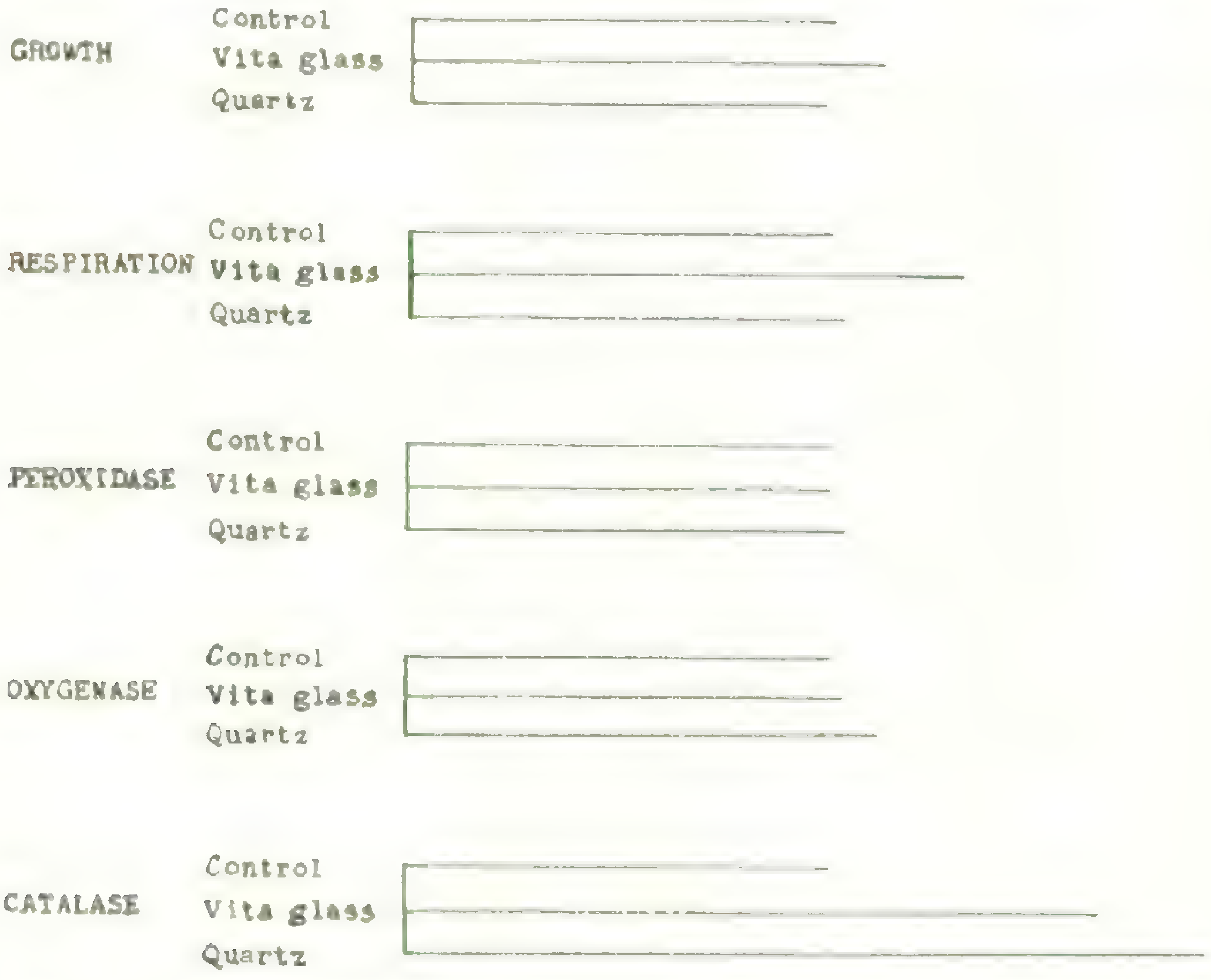

Fig. 3. Determinations made on tomato plants day after irradiation ceased. Plants had been irradiated at 100 inches for 10 minutes daily for 5 weeks. Linear values calculated as percentages of the control.

the quartz water cell were very similar to those obtained by the use of the Vita glass water cell, with an indication of a possible injury of the plants.

Experiment III.—The tomato plants used for this experiment were planted February 15, 1934, and transplanted from the flats to 4-inch pots on April 5. The raying began April 20, at a distance of 36 inches from the arc. The quartz water cell was used as a filter. One group was rayed 15 minutes, and another group 30 minutes, daily for 7 days. Determinations

were made daily for 4 days following the irradiation period. The data are included in table III, and are represented graphically in figs. 4–7 inclusive.

All of the rayed plants in this experiment were greatly injured. The first set of determinations, made the day after the

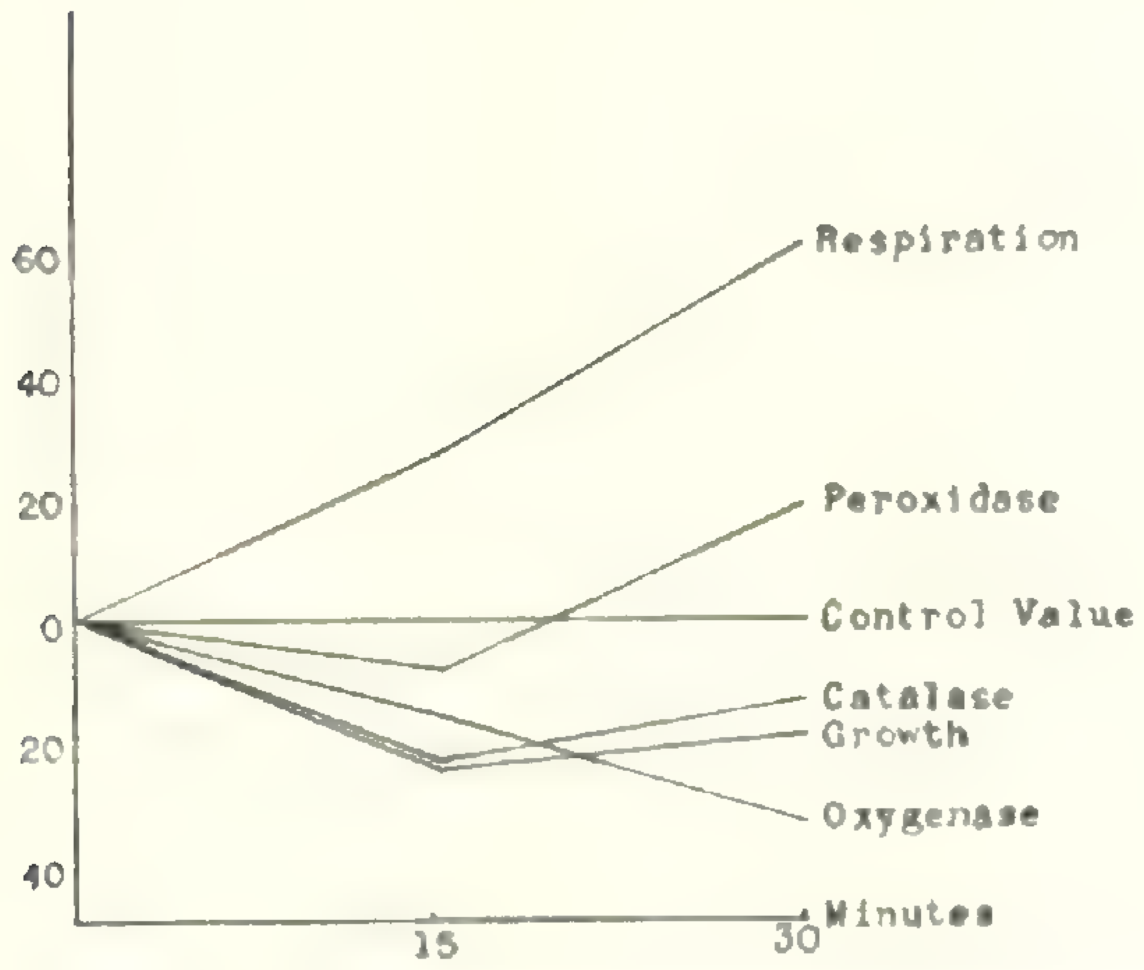

Fig. 4. Determinations made on tomato plants after being rayed at 36 inches for 7 days with quartz water-cell filter.

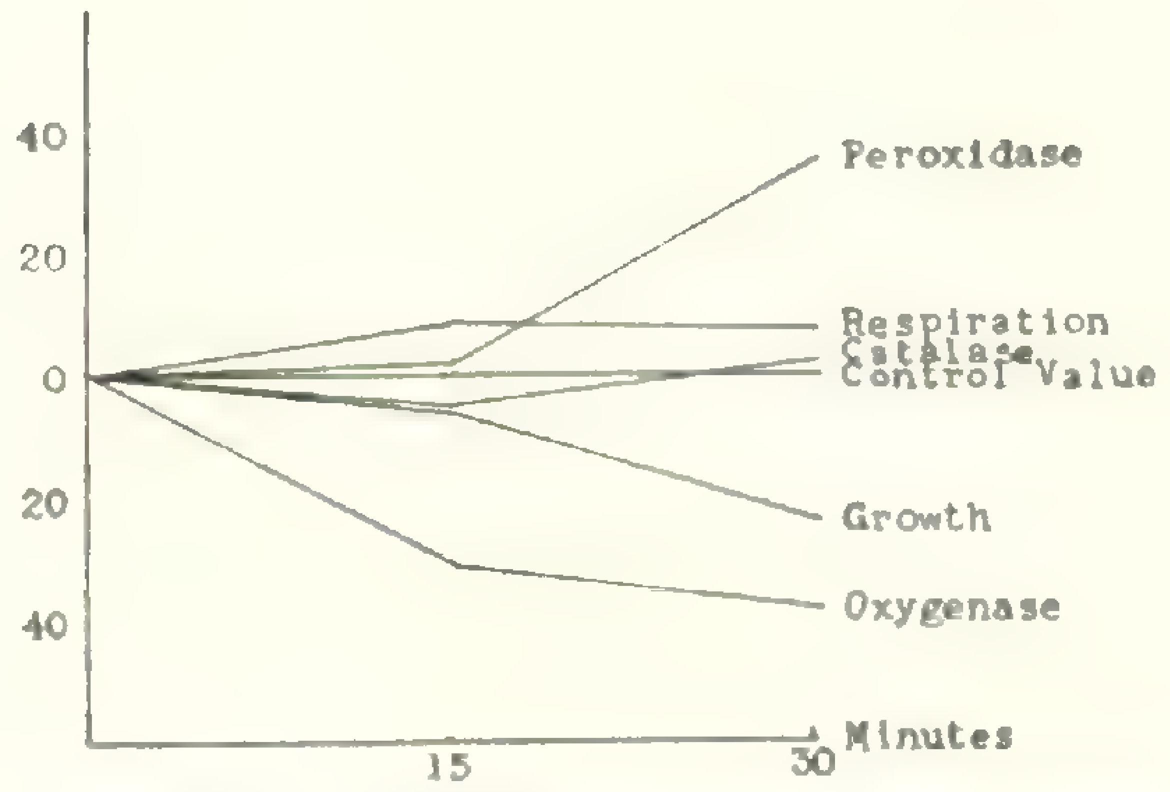

Fig. 5. Determinations made on tomato plants on the second day after irradiation ceased.

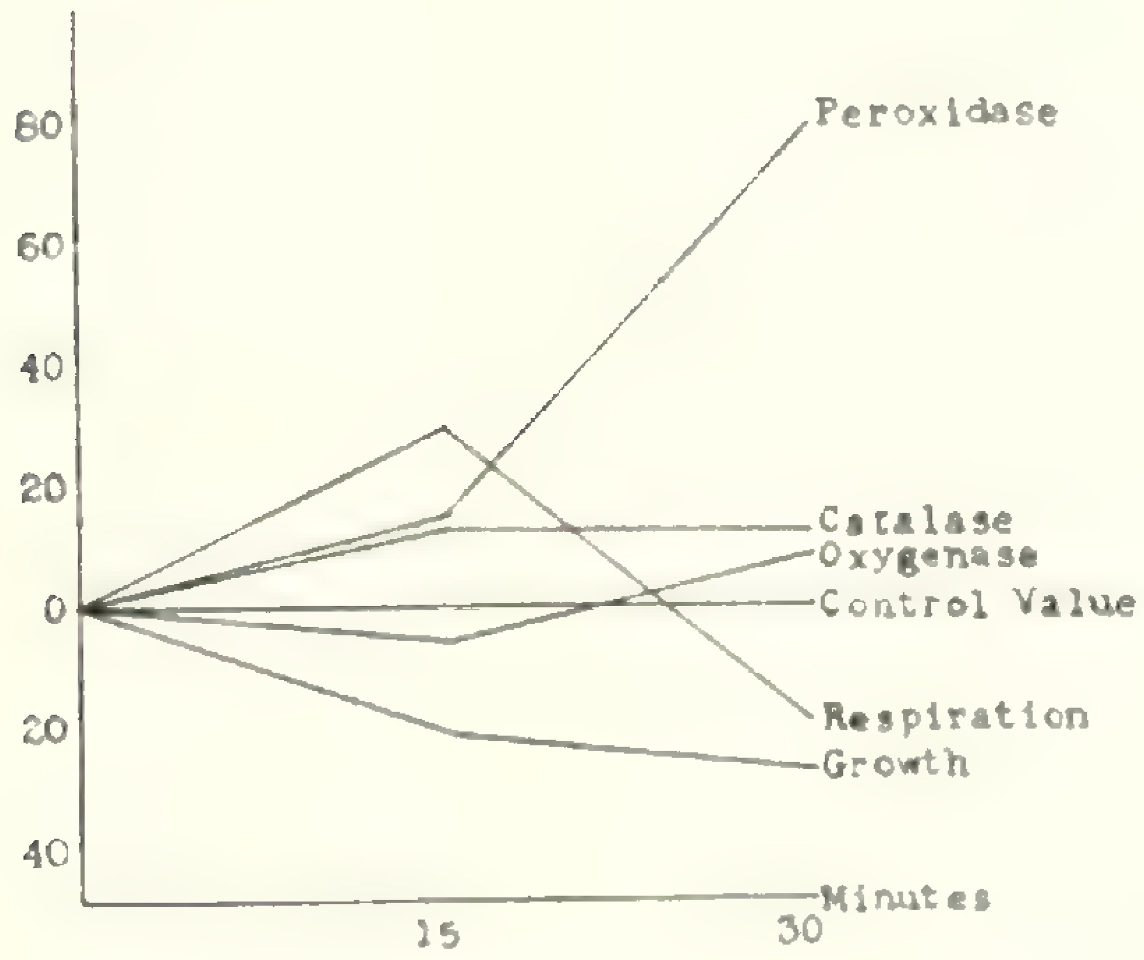

Fig. 6. Determinations made on tomato plants on the third day after irradiation ceased.

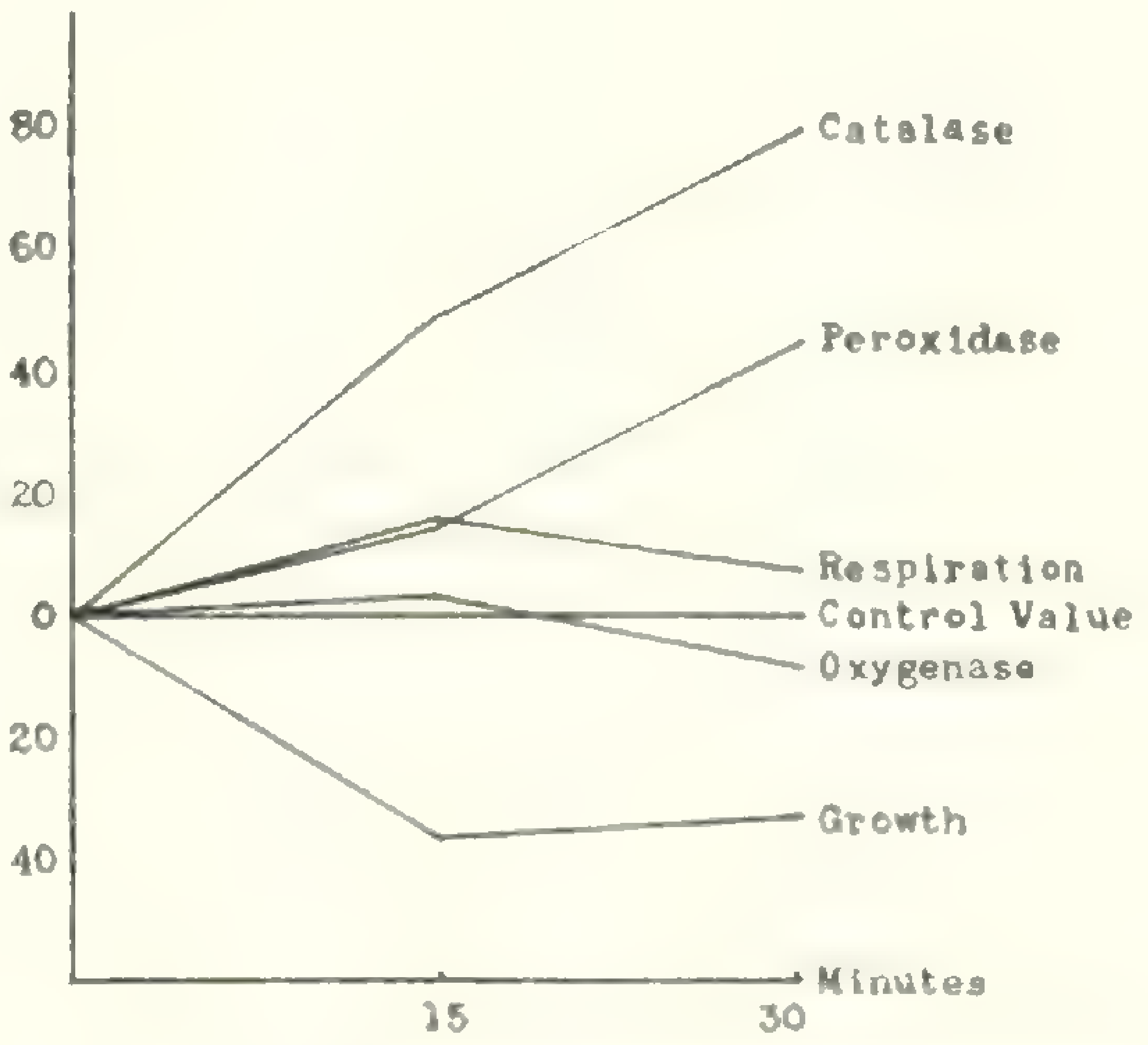

Fig. 7. Determinations made on tomato plants on the fourth day after irradiation ceased.

irradiations ceased, showed a heightened rate of respiration that was proportional to the length of exposure. On subsequent days the amount of carbon dioxide eliminated per gram of fresh weight remained at the heightened level in those plants rayed for 15 minutes daily, but there was a great drop in respiration on subsequent days in those plants which

TABLE III

RESULTS OF IRRADIATING 5 TOMATO PLANTS THROUGH QUARTZ WATER CELL AT 36 INCHES DAILY FOR 7 DAYS, CALCULATED IN PERCENTAGES OF THE CONTROL

Treatment	Fresh wt. in gms. of tops		CO_2 elimination		Relative percentage of enzymatic activity		
	Actual	Relative	Per gm. fresh wt.	Relative	Catalase	Oxygenase	Peroxidase
First determination							
Control	60.2	100	.00130	100	100	100	100
Rayed 15 minutes	46.5	77	.00165	127	77	85	92
Rayed 30 minutes	49.0	81	.00209	161	87	67	119
Second determination							
Control	57.4	100	.00219	100	100	100	100
Rayed 15 minutes	53.9	94	.00235	108	75	67	102
Rayed 30 minutes	43.8	76	.00223	107	104	62	135
Third determination							
Control	80.4	100	.00174	100	100	100	100
Rayed 15 minutes	64.2	79	.00208	129	117	94	115
Rayed 30 minutes	58.7	73	.00153	89	112	108	179
Fourth determination							
Control	86.7	100	.00228	100	100	100	100
Rayed 15 minutes	54.4	63	.00264	116	149	103	115
Rayed 30 minutes	59.1	67	.00248	109	180	91	145

had been rayed for 30 minutes daily. This drop is only apparent, because there were progressively larger amounts of withered and dead tissue in these greatly injured plants on each succeeding day. Since these non-respiring tissues were unavoidably included in the recorded fresh weight, a false value is obtained. This was not an important source of error in those

TABLE IV

RESULTS OF IRRADIATING 5 BEAN PLANTS AT 70 INCHES FOR 10 MINUTES DAILY FOR 5 WEEKS, CALCULATED IN PERCENTAGES OF THE CONTROL

Treatment	Fresh wt. in gms. of tops		CO_2 elimination		Relative percentage of enzymatic activity	
	Actual	Relative	Per gm. fresh wt.	Relative	Peroxidase	Catalase
First determination						
Control	92.5	100	.0053	100	100	100
Rayed through Vita glass water cell	74.5	81	.0053	100	150	91
Rayed through quartz water cell	59.8	64	.0049	92	237	100
Second determination						
Control	70.0	100	.0062	100	100	100
Rayed through Vita glass water cell	58.0	83	.0057	92	119	95
Rayed through quartz water cell	45.0	63	.0068	109	145	108

plants rayed 15 minutes daily. Since the enzymes were determined in the extracted sap, these values represent more truly the comparative activities of the actually living tissue. The peroxidase, with the exception of a single determination, followed the upward trend of respiration. Oxygenase was greatly decreased during the first 2 days after the irradiations ceased,

the decrease being proportional to the length of exposure, but normal values were regained on the third and fourth day. Catalase showed a progressive increase for the four days following the termination of the raying. The activity of catalase shows no apparent relationship to respiration nor to the activities of peroxidase and oxygenase.

Experiment IV.—For this experiment, Red Kidney field beans were planted in flats January 23, 1934, and transplanted

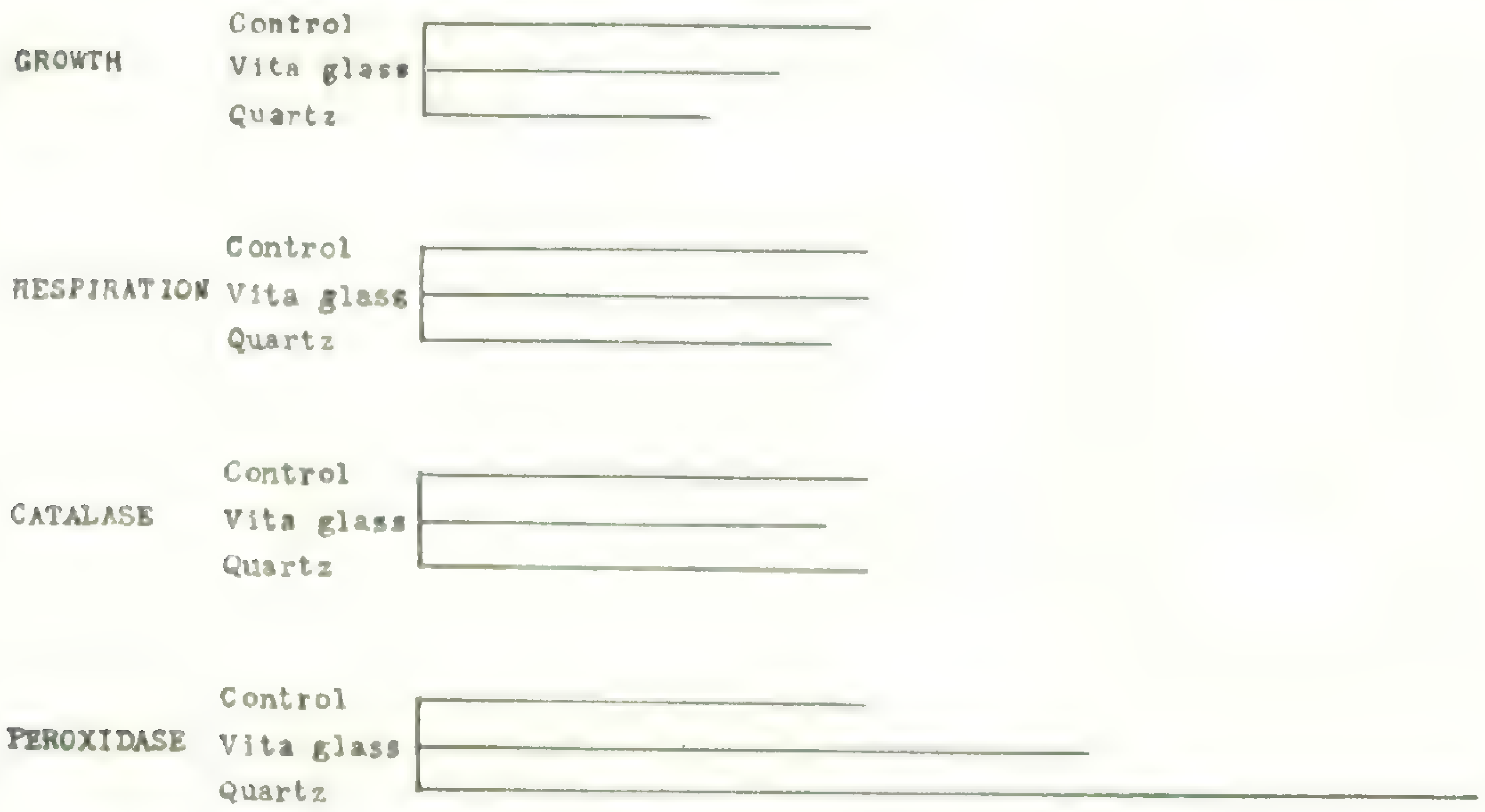

Fig. 8. Determinations made the day after irradiation ceased on bean plants rayed at 70 inches for 10 minutes daily for 5 weeks. Linear values calculated in percentages of the controls.

into 4-inch pots February 8. The irradiation began February 15, and continued for 5 weeks. The distance was 70 inches, and the daily exposure was 10 minutes. One group was rayed through the quartz water cell, and one through the Vita glass water cell. One set of determinations was made the day after the irradiations ceased, and another 4 days later. The results are presented numerically in table IV and graphically in figs. 8 and 9.

All irradiated plants showed injury. The injury and stunting were slight in those plants rayed through the Vita glass water cell, but quite pronounced in those rayed through the quartz water cell. Respiration and catalase were not signifi-

cantly affected, but peroxidase was very markedly increased in both rayed groups, particularly when the quartz water cell was used as the filter. Five days after irradiation ceased these differences were still evident although of lesser magnitude. The tomato plants in experiment II were rayed under approximately similar conditions, but they were stimulated in growth, respiration was slightly increased, peroxidase was insignificantly affected, and catalase was very greatly stimulated.

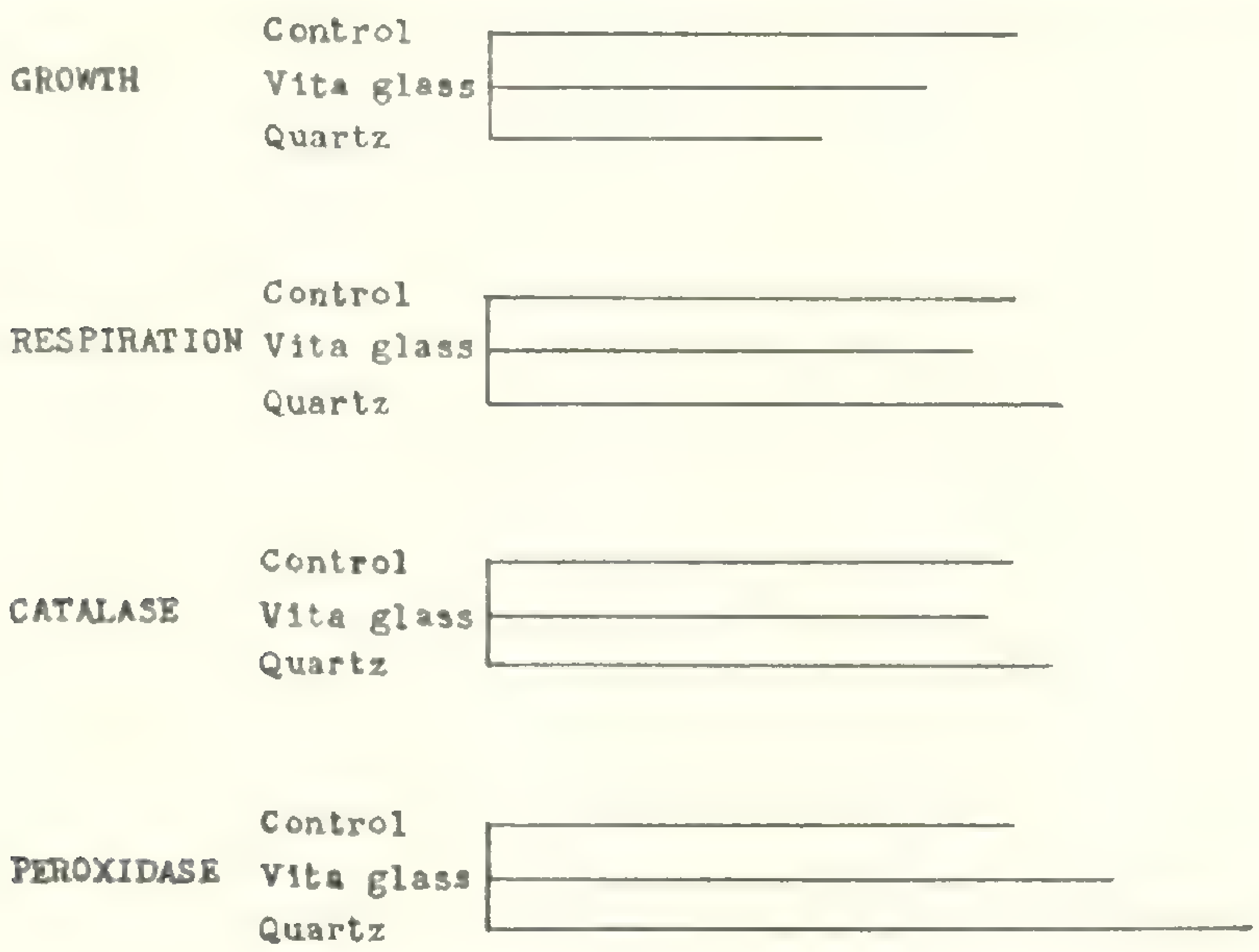

Fig. 9. Determinations made 5 days after irradiation ceased on bean plants rayed at 70 inches for 10 minutes daily for 5 weeks. Linear distances calculated in percentages of the controls.

DISCUSSION

These experiments on irradiated tomato plants show that the rate of respiration as indicated by the amount of carbon dioxide eliminated per gram of fresh weight markedly increases proportionally to the extent of injury. However, it is not possible to obtain accurate numerical data on plants in the most advanced state of injury because the development of dead, non-respiring tissue confuses the weights. This increased rate of respiration is approximately paralleled by the activitiy of peroxidase in the expressed juice. Oxygenase, on the other hand, is inhibited proportionally to the extent of raying. Experiment III shows that normal oxygenase activity is regained

soon after irradiation stops, although the plants remain in a very disturbed physiological condition. Catalase reacts variously. In experiment I it was stimulated, yet in experiment III determinations made the day after raying ceased gave subnormal values. On successive days its activity increased until a considerable degree of stimulation was reached. These results agree with those of Fuller ('32).

The irradiated bean plants reacted somewhat differently. Their growth was not stimulated under conditions stimulative to tomatoes. In experiment IV, the only decided effect was a greatly stimulated peroxidase activity, while the tomato plants under the approximately similar conditions of experiment II showed a greatly stimulated catalase activity as the chief physiological reaction. Bean plants do not give the colorimetric test for oxygenase, and this is itself sufficient evidence that the physiology of beans is different from that of tomatoes. It is not surprising, then, that beans and tomatoes react differently in regard to other features of their physiology.

The data obtained in these experiments have a bearing on the nature of the oxidation processes in plants. The numerous contributions of Bach and Chodat on the intracellular oxidation mechanism have been responsible for the concept that oxygenase unites molecular oxygen to some cellular component to form a peroxide. This peroxide is then activated towards some oxidizable substance in the protoplasm by peroxidase. It is obvious that if this relationship be true, then oxygenase and peroxidase would necessarily be related quantitatively to each other. This is indeed suggested by numerous experiments upon diseased plant tissues in which both enzymes were markedly greater in activity than in normal plants. A summary of these experiments has been published by Wynd ('34).

The necessity of oxygenase for the respiratory process is, however, open to several serious objections. Onslow ('21, '31) has shown that only about 60 per cent of the higher green plants give the oxygenase reaction and that any fundamental component of the respiratory mechanism would be more universally distributed. Kertesz ('34) has shown that fresh tis-

sue of some varieties of peaches does not discolor upon exposure to the air. Qualitative and quantitative studies showed the lack of catechol compounds in the non-discoloring varieties. This indicates that the oxygenase-catechol system may be absent even in very closely related plants, and consequently could not be of fundamental importance.

Wynd ('34) has shown, in an extended study of the tomato plant, that there is no quantitative relationship between the activities of oxygenase and peroxidase. Plants stimulated to great respirational activity by the addition of potassium iodide to the nutrient solution showed a corresponding increase of peroxidase but oxygenase was greatly inhibited. These results, together with those of the present paper, tend to indicate that the oxygenase-catechol-peroxidase system does not represent a fundamental respiratory mechanism in the tomato plant.

SUMMARY

1. Tomato and bean plants were rayed under various conditions by a mercury arc, and the effect on respiration and oxidizing enzymes determined.

2. In tomato plants, *injurious* raying stimulated respiration and peroxidase. Oxygenase was inhibited, and catalase reacted variously but in general was stimulated. The most pronounced effect of *non-injurious* raying was greatly stimulated catalase.

3. In bean plants, comparatively weak dosages produced greatly stimulated peroxidase as the chief reaction. Bean plants did not exhibit oxygenase activity, which indicates a different chemical physiology consistent with their different reactions to ultra-violet light.

4. The comparative activities of peroxidase and oxygenase show that the oxygenase-peroxide-peroxidase system as proposed by Bach and Chodat does not represent a fundamental respiratory mechanism in the tomato plant.

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STUDIES IN ULTRA-VIOLET AND RESPIRATORY PHENOMENA. III

The Influence of Various Regions of the Spectrum on the Anaerobic Fermentation of Yeast[1]

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As was pointed out in the first paper of this series,[2] the claim that ultra-violet irradiation stimulates the fermentation of yeast is based on very insecure foundations. The recent revival of this claim warrants a new and more critical approach to the problem. The present paper reports the results of an attempt to duplicate the essential features of the work of Owen[3] but under more accurately controlled experimental conditions.

EXPERIMENTAL PROCEDURE

The CO_2 elimination was determined by observing the positive pressure developing in the Barcroft differential manometer. Similar vessels were attached to each arm, one vessel receiving the yeast suspension while the other remained empty. Both were thoroughly swept out with nitrogen and the manometer taps immediately closed. After shaking for 30 minutes in

[1] The investigations reported in this paper were carried on through aid from the Science Research Fund of Washington University, St. Louis, provided by the Rockefeller Foundation.

[2] Wynd, F. Lyle, and Reynolds, E. S. Studies in ultra-violet and respiratory phenomena. I. Review of work published before June, 1935. Ann. Mo. Bot. Gard. **22**: 771–835. 1935.

[3] Owen, W. L. Ultra-violet irradiation stimulates yeast activity. Food Industries **5**: 252–254. 1933.

the water bath, the taps were opened and the manometer liquid allowed to come to equal levels in each arm. The taps were then closed, and the positive pressure plotted by frequent readings.

The vessels were of the type shown in fig. 1. The total volume was about 12 cc. Chamber A received the culture suspension and Chamber B an alkali when CO_2 absorption was desired. A metal shield protected the manometer from the heat of the mercury arc.

The water bath was of the Warburg type in which the temperature was held to 25° C., ± .001° C. by a sensitive Thyratron

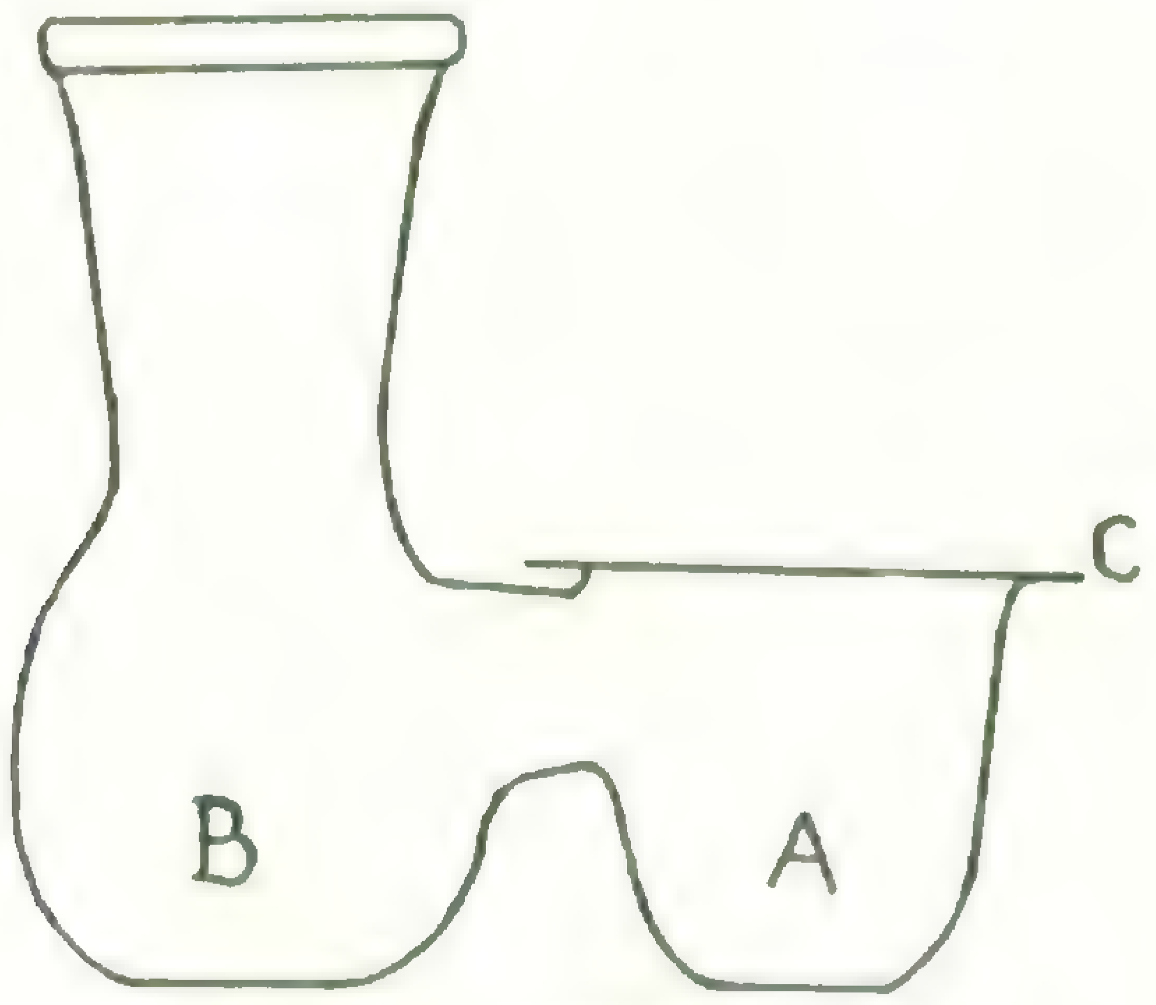

Fig. 1. Respirometer vessel: A, culture chamber; B, alkali chamber; C, quartz cover glass.

relay. The manometers were shaken at the rate of 100 excursions of 4 cm. in length per minute.

The source of irradiation was a Burdick quartz mercury arc suspended immediately above the respiration vessel and removed 25 cm. from the thin quartz plate C. The quartz plate C was immersed 3 cm. below the surface of the water of the water bath. A conveniently built rack allowed the various filters to be placed several cm. above the water surface. A quartz tray, containing water 1 cm. deep, was suspended just below the arc itself. This was necessary to prevent the heat from the arc from cracking the filters, some of which were very fragile.

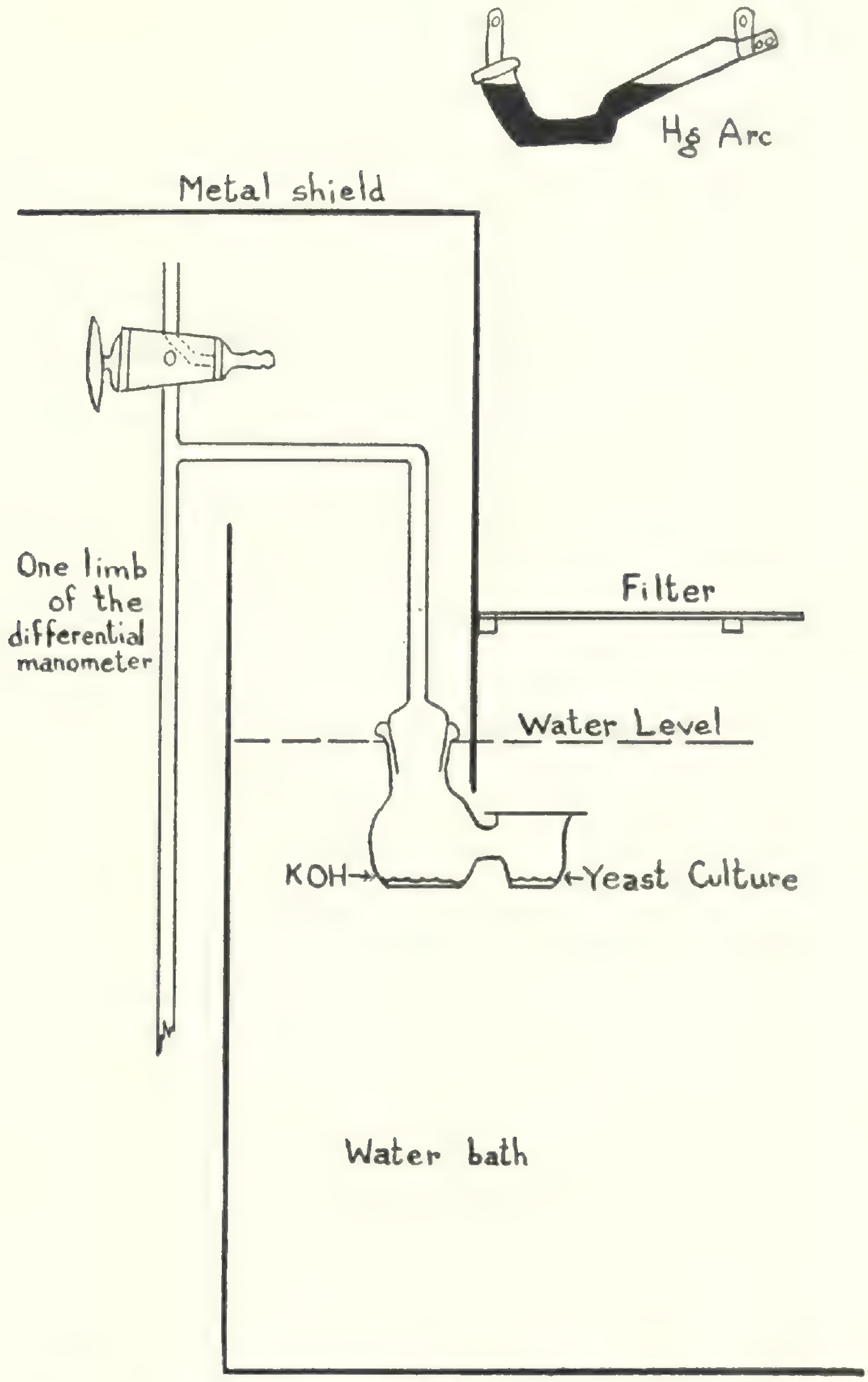

Fig. 2. Arrangement of the apparatus for raying yeast cultures. The alkali is omitted in fermentation experiments.

Through this set-up also the infra-red radiations were eliminated. The following light filters were used:

Red Purple Corex A, No. 986—about 4.0 mm.
Chemical Pyrex Plate—2.1–2.6 mm.
Blue Purple Ultra, No. 585—4.4–4.6 mm.
Red Purple Ultra, No. 597—4.5–5.4 mm.
Nultra, No. 385
Noviol Shade "O," No. 306
Vita glass—2.6–3.0 mm.

The transmissions of these filters are indicated in fig. 3.

Pasteur's yeast medium was used as the substrate. Its composition was:

150.0	gms. glucose
10.0	gms. ammonium tartrate
2.0	gms. mono-potassium phosphate
0.2	gms. calcium phosphate
0.2	gms. magnesium sulphate
1000.0	cc. water

Since autoclaving causes this medium to turn brown if sugar is present, aliquots of 100 cc. were sterilized without the sugar, and 15 gms. of glucose were added just before use. Fleischman's commercial baker's yeast was obtained in pound cakes, only the center portion being used, and 7 gms. of it were seeded in the 100-cc. portions. The seeded medium was vigorously aerated at 25° C. for 30 minutes. Three drops, or about 0.1 of a cc., were then delivered into chamber A of the vessel shown in fig. 1.

The cultures were not pure in the bacteriological sense, but preliminary tests showed that at 25° C. the medium allowed no significant bacterial growth during the short time that each experiment lasted. As may be seen from the graph in figure 4 for the control culture, the fermentation curve over the period represented was practically a straight line. This period is the second hour of the life of the culture, since half an hour was spent in the preliminary aeration, and half an hour in temperature equilibration.

Each experiment was repeated three times with identical results. Almost every determination was made on a separate cake of yeast, thus eliminating the possibility of the results being due to some specific physiological condition of the sample.

RESULTS

No effect on anaerobic fermentation was produced by the irradiation passed through any of the following filters: Blue Purple Ultra No. 585; Red Purple Ultra No. 597; Nultra No. 385; Noviol Shade "O," No. 306. All negative experiments were duplicated with a total of only 1.5 cm. of water intervening between the culture and the light, in order to obtain the maximum intensity of irradiation, and in no instance were the results altered. By referring to fig. 3, it is seen that these ineffective regions consist of wave lengths longer than 3000 Å.

A comparison of figs. 3 and 4 shows that spectrum regions containing wave lengths shorter than 3000 Å produce an inhibition progressively greater as the wave lengths become shorter. Probably the first inhibitory line is 2967 Å, from which point the irradiation becomes increasingly toxic. It should be noted, however, that possibly some of the mild inhibition under the chemical Pyrex filter may be due to the mercury arc line of 3024 Å, since it is excluded by the Blue Purple Ultra filter which gave no inhibition. In all instances, this inhibitory effect on the CO_2 elimination was detectable manometrically within five minutes.

It is interesting to note that the Red Purple Corex A, No. 986 filter passed radiations that are conspicuously more effective than did the Vita glass. This Corex glass differs qualitatively from Vita glass chiefly in its transmission of the strong line at 2537 Å. Irradiation of this wave length apparently is very toxic, since only about 5 per cent of its intensity calls forth an inhibition about 50 per cent greater than the combined effect of all longer wave lengths. It should be noted, however, that the Corex filter passes these radiations at a somewhat greater intensity than does Vita glass. The increase in area under the graph line (fig. 3), for wave lengths less than 3000 Å,

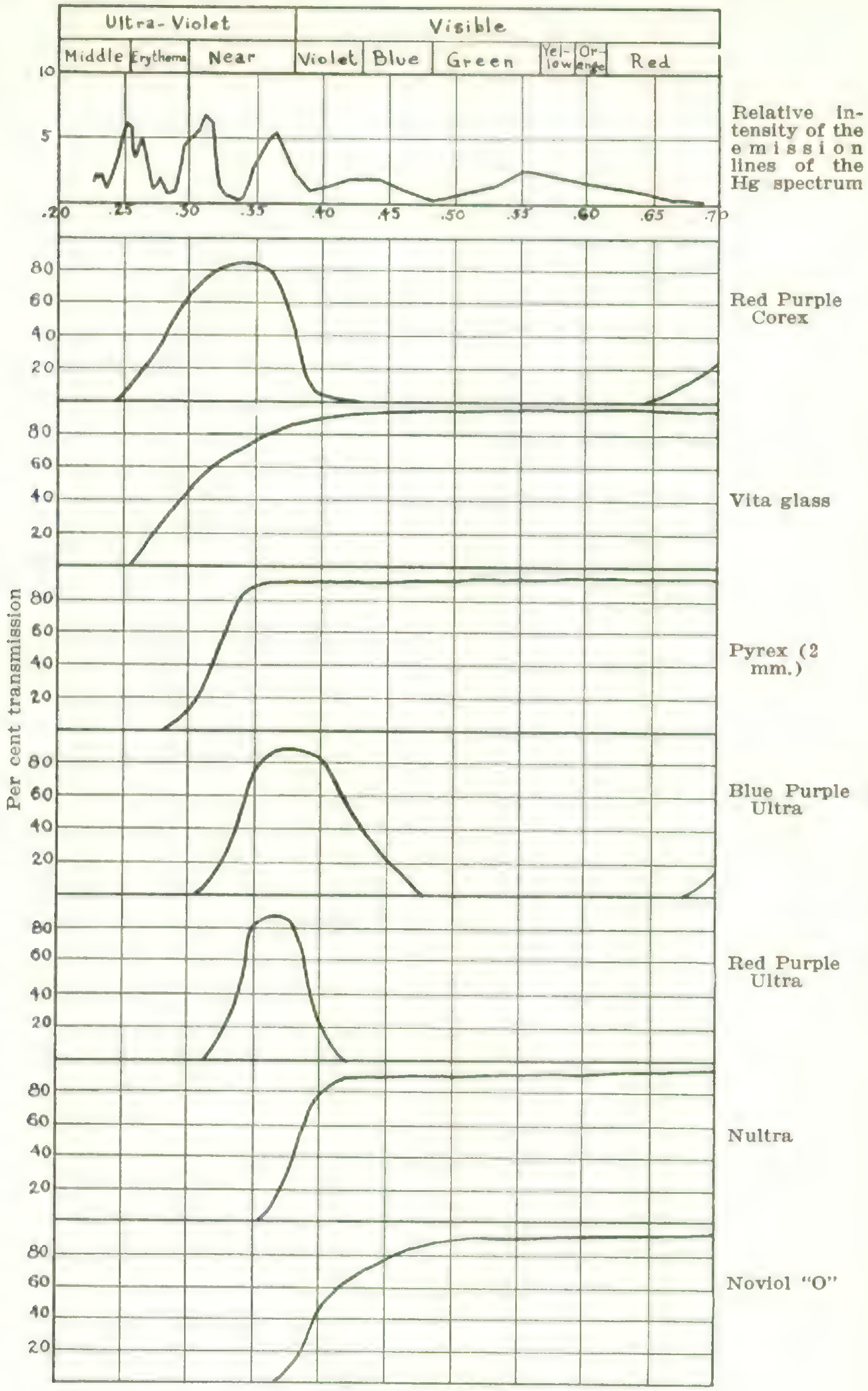

Fig. 3. Transmission of various filters.

for Vita glass as contrasted with Pyrex is about nine times, while the increase in inhibition is only about 60 per cent. This lack of proportionate relationship is probably due to the relatively low intensity of the radiations in this portion of the mercury arc. The corresponding comparison between Vita glass and the Corex filters is less than twice the area for the latter

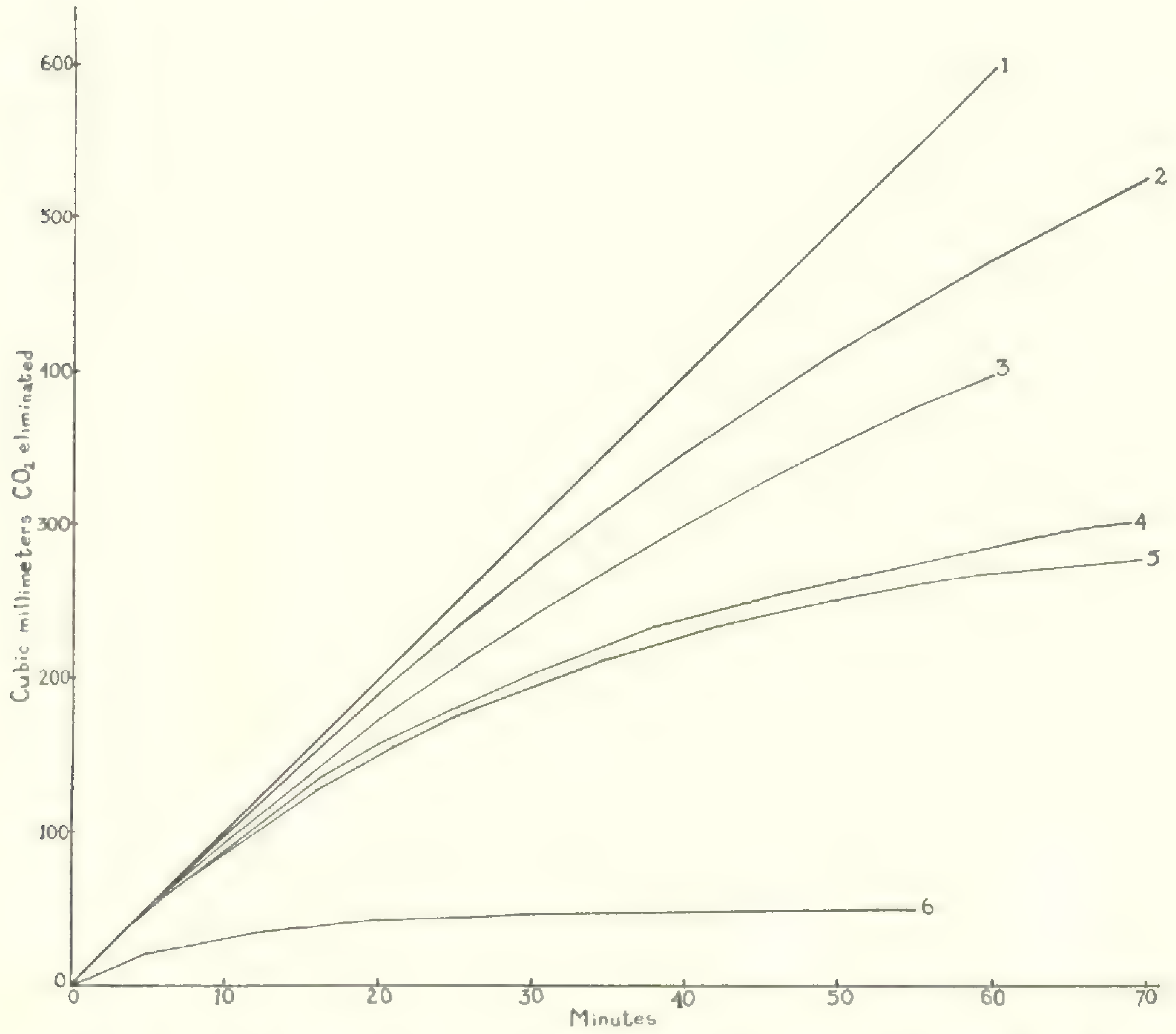

Fig. 4. Curve 1, Control; 2, irradiated through Pyrex and 4 cm. water; 3, irradiated through Vita glass and 4 cm. water; 4, irradiated through Red Purple Corex A and 1.5 cm. water; 5, irradiated through Red Purple Corex A and 4 cm. water; 6, irradiated by the open arc through 4 cm. water.

with an 80 per cent increase in inhibition. This close relationship is due no doubt in part to the relatively great intensity of the radiation of 2537 Å. Thus it appears that this increased inhibition associated withe the Corex filter may be due to some extent to qualitative difference in the radiations transmitted and partly also to quantitative difference.

Curves 4 and 5 in fig. 4 are as close together as experimental error in the duplication of cultures would permit, and they in-

dicate that the difference in intensity produced by 4 and by 1.5 cm. of water was not sufficiently great to influence the results. Comparison of figs. 3 and 4 reveals that the inhibitory irradiation begins with the most effective erythemal region.

At the end of each experiment, the cells were treated with 1/2000 methylene-blue (final concentrations) to test for injured or dead cells. The unscreened arc produced complete staining at the end of 50 minutes of irradiation. No staining was observed when any of the filters described were used. If the staining of yeast by methylene-blue is accepted as evidence of injury this shows that the observed inhibition is a specific effect and not dependent upon a general injury to the cells. The inhibition due to death of the cells is much more profound and sudden as shown by the curve for the open arc in fig. 4.

CONCLUSIONS

The results of this investigation indicate that ultra-violet between 3000 and 2500 Å has an inhibiting effect upon the fermentative activity of suspensions of two-hour-old cultures of baker's yeast when made in the very favorable Pasteur medium.

This inhibition of fermentation is a specific effect and is not dependent on a general injury to the cell. The degree of inhibition of fermentation is both a qualitative and a quantitative function of ultra-violet.

Irradiations of longer wave length than 3000 Å are without effect.

A NOTE ON THE APPLICATION OF THE GLASS ELECTRODE TO THE DETERMINATION OF OXIDATION-REDUCTION POTENTIALS

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The electromotive force of the chain consisting of a glass electrode and a bare noble metal is influenced by the presence of oxidation-reduction systems in the solution. It has been frequently stated that such an electrode system may be used to determine oxidation-reduction potentials independently of simultaneous effects of pH, but this statement must be extensively qualified, as will be seen from the following discussion.

Ignoring the small asymmetry potential existing between the two glass surfaces, there are four sources of electrical activity in the chain. They are the half cell inside the glass electrode, the liquid-glass interface potential on the inner surface of the glass, the glass-liquid interface potential on the outer surface of the glass, and the oxidation-reduction potential imparted to the platinum. Any solution containing an oxidation-reduction system in which the glass electrode and the platinum electrode are immersed will affect the electromotive force of the chain in two ways. The oxidation-reduction system will impart a potential to the platinum, and the hydrogen ions present will modify the glass-liquid interface potential on the outer surface of the glass.

If the pH of the solution remains constant, then only changes in the oxidation-reduction potential will modify the E.M.F. of the chain. The true E_h of the oxidation-reduction system may be calculated by applying a calibration correction obtained by observing the E.M.F. of the chain when immersed in some known system at the same pH as that of the unknown

system. If the pH of the solution changes during the course of oxidation-reduction potential measurement, either of two conditions may exist. A consideration of the formula is necessary for their explanation:

$$E_h = E_o - \frac{RT}{nF} \ln \frac{(\text{reductant})}{(\text{oxidant})} - \frac{RT}{nF} \ln \frac{(\text{reductant})}{(\text{oxidant})} - \frac{RT}{nF} \ln \frac{K_a}{(H^+) + K_a}$$

The oxidation-reduction potential is seen to be a function of the ratio of total reductant to total oxidant, and also of pH.

First, if the system is such that the slope of the curve relating changes in pH to changes in oxidation-reduction potential is the same as that relating changes in pH to changes of the glass-liquid interface potential, then these two effects of pH cancel each other and the potentials of the system would correspond to those obtained at a constant pH. It is this that has given rise to the statement that the glass electrode records oxidation-reduction potential independently of pH changes. The falsity of this view comes from the fact that the observed reading must be corrected by an empirical factor obtained by observing the potential given by a known oxidation-reduction system at the same pH as that of the unknown. The magnitude of this calibration correction *changes* with pH, and hence its application to the observed reading will not give the E_h of the solution if the pH has changed from that of the calibrating system. In order to obtain the true E_h of a system of changing pH, determinations of pH must be made simultaneously with those of oxidation-reduction potential, from which new calibration corrections can be calculated.

On the other hand, if the system is such that the slope of the curve relating changes in pH to changes in oxidation-reduction potential is unlike that relating changes of pH on the glass-liquid interface potential, then the two effects of pH do not cancel each other. In order to convert observed potentials to E_h one would need to take simultaneous measurements of pH changes, and then apply as a correction factor only that part of the pH effect that is cancelled by the response of the glass electrode to the same pH changes. This would be a complicated

and tedious process—and only possible if the reaction of the redox system to changes in acidity were accurately known. Clark and Cohen[1] were the first to point out the various theoretically possible relationships between pH and oxidation-reduction potentials. They show how very complex is the effect of pH on many oxidation-reduction systems. For this reason, it is impossible to use this chain to determine the E_h of such complex biological systems as growing bacterial cultures, if the pH is changing simultaneously.

The use of the glass electrode in the determination of oxidation-reduction potentials is limited to buffered solutions, and its advantage lies solely in its high resistance and consequent lack of polarization. A high resistance (10 megohms) inserted in the usual calomel-platinum chain would be equally advantageous.

It may be pointed out that if the potential of the oxidation-reduction system changes with pH to the same degree as does the glass-liquid interface potential, then the observed E.M.F. of the oxidation-reduction system will be in terms of the pH *inside* the glass electrode. This apparently anomalous phenomenon has a simple explanation.

If the outside solution contains no oxidation-reduction system and is at the same pH as the fluid inside the glass electrode, then, ignoring the asymmetry potential, the potentials on the glass surfaces cancel each other, since they are functions of pH and are exerted in opposite directions. Again, for simplicity, ignoring certain possible ionic effects on the platinum, there remains in the chain but a single effective source of electromotive force, the half cell inside the glass electrode. Since a single source of electrical potential cannot be measured, there will be no E.M.F. detected in the system. Now, if quinhydrone be added to the outer liquid, a potential will be imparted to the platinum whose magnitude in comparison with the normal hydrogen electrode will be defined by the equation given above.

[1] Clark, W. M., and Cohen, B. Studies on oxidation-reduction. II. An analysis of the theoretical relations between reduction potentials and pH. U. S. Public Health Reports 38: 666–683. 1923.

The effective sources of electromotive force in the glass electrode-platinum chain consist of only the half cell inside the glass electrode and the oxidation-reduction potential imparted to the platinum, since the interface potentials on the glass surfaces cancel each other. The potential of the half cell inside of the glass electrode can be expressed in terms of the normal hydrogen electrode (E_h) by applying a suitable correction, and then the system reads the E_h of the oxidation-reduction system in terms, of course, of the pH, which under the conditions defined above is the same on both sides of the glass.

Now, if the pH of the solution in which the oxidation-reduction system is dispersed is changed by one pH unit, then the oxidation-reduction potential on the platinum changes by 59 millivolts (at 25° C.). However, this effect on the electromotive force of the oxidation-reduction system is the same quantitatively as that on the glass-liquid interface potential. These effects, therefore, cancel each other and the total E.M.F. of the chain will read as before. If the original pH equals 1.00 on both sides of the glass membrane, then it can be seen that no matter how the pH of the oxidation-reduction system outside be changed, the reading will still represent the E_h of the system at pH = 1.00. But if the pH outside the glass electrode remains at 1.00, and the pH inside is changed by 1 pH unit, the pH effect is no longer cancelled and the total E.M.F. of the chain will change 59 millivolts. The chain again does not indicate the E_h of the oxidation-reduction system, since that obviously has not changed. But the magnitude of this change, which is the pH effect on the inner surface of the glass, is the same as the change of oxidation-reduction potential if it were varied by this same pH unit.

It is now clear that the observed potential of all oxidation-reduction systems which vary 59 millivolts with a change of acidity of one pH unit will depend on the pH inside of the glass electrode, and curiously enough not that of the liquid in which the system is actually dispersed.

The validity of the above discussion depends on the assumption that the half cell inside the glass electrode is a metal in

equilibrium with its ions such as Ag: AgCl or Hg: HgCl. If this electrode is a noble metal in equilibrium with an oxidation-reduction system, e. g., platinum: quinhydrone, then the observed potential of the system will be the difference in millivolts between the oxidation-reduction potentials of the system inside and that outside the glass electrode, both dispersed in solutions of equal hydrogen ion concentration. Reconsideration of the above discussion will show that this will be true regardless of how the actual pH of the two solutions differ from each other, providing only that the pH of each is such that both systems vary 59 millivolts per pH unit change.

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